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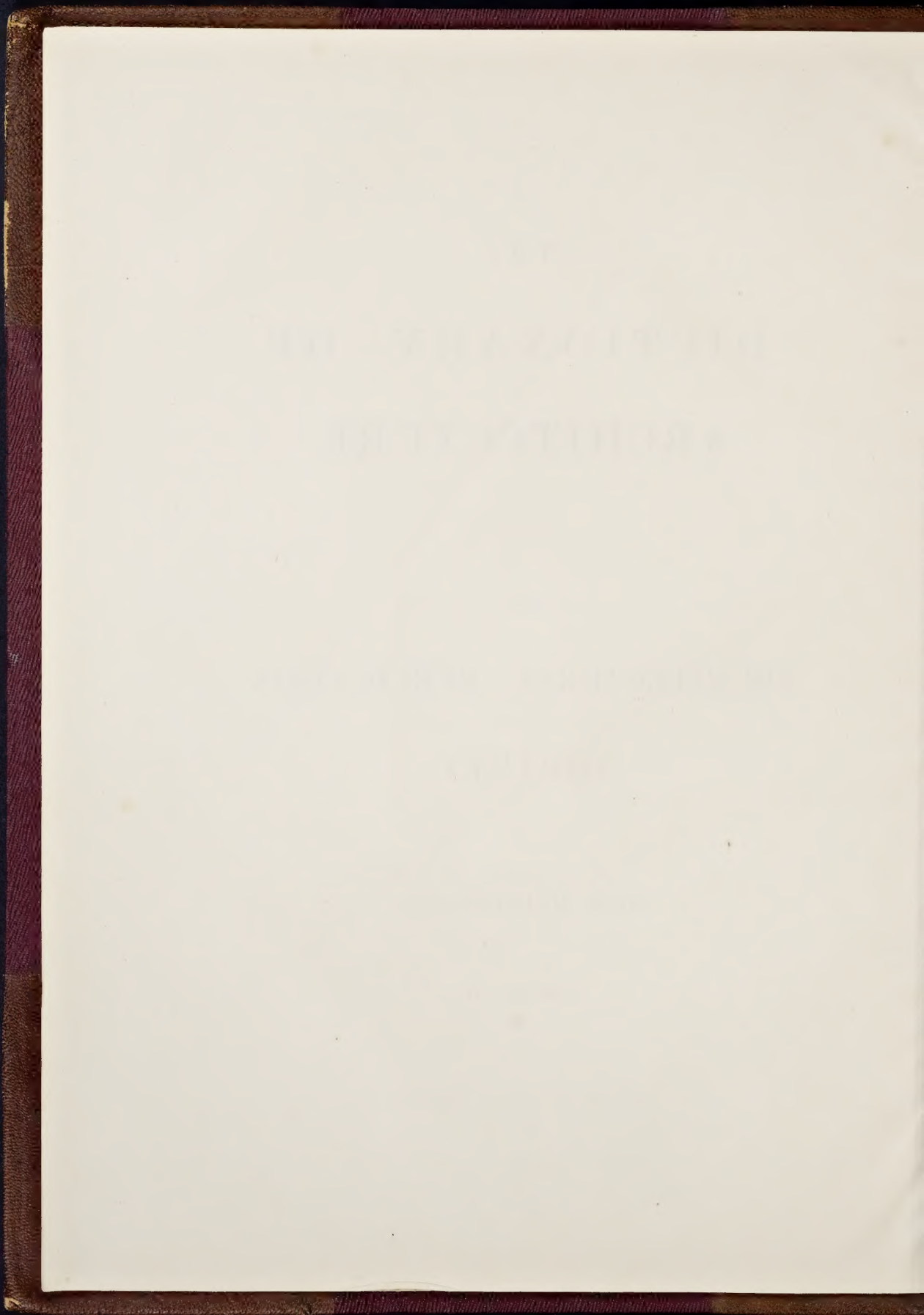
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THE DICTIONARY OF ARCHITECTURE.

EAGL

EADGHA or **EEDGAH**. A term commonly explained as a roofless mosque. It is properly the name, throughout great part of Hindostan, of a place destined for the performance of some solemn festivals by the Mohammedans. An external view of one, near Chaynpore in Behar, is given in **DANIELL**, *Oriental Scenery*, fol., London, 1815, v, pl. 15, who observes that it is of an open quadrangular form, and extremely plain internally.

EAGLE. The emblem of this bird was frequently used as an ornamental accessory to a building. It was adopted, as stated by **XENOPHON**, *Cyrop.*, vii, 1, and *Anab.*, i, 10, for the ensign of the Persians; and was consecrated by the Greeks and Romans to Jupiter. It not only served as a decoration for the top of the ivory rod or sceptre borne by Roman kings and consuls, but it appears on Roman imperial, as well as on Agri-gentine, Ptolemaic, and Syrian coins. It became B.C. 104 an ensign of each Roman legion, and for this purpose it was generally made of silver, because that metal is more visible at a distance than gold; **PLINY**, *H. N.*, x, 5, xxxiii, 19.

The date of the invention of the double-headed eagle is very uncertain, as admitted by **FESCIUS**, *De Insignibus*, 4to., Altdorf, 1727, pp. 100-3, correctly disputing an assertion made in the *Analecta ad Militiam Rom.* by **LIPSIUS**, *Opera*, 8vo., Wesel, 1675, iii, 435, who states that he had seen somewhere (he thinks on the column of Antonine, where it does not seem to appear at all) an antique double-headed eagle: that engraved in **BORDETTI**, *Cimiteri*, fol., Rome, 1720, p. 262, is shown therein to be a forgery; and although it exists among the decorations of the wooden doors, cc. 1200-50, from the palazzo reale at Palermo, given in the *Illustrations*, 1858-9, yet the use of this form, by the emperors of Germany, does not seem to occur on their coins before 1314-7, or on their seals before 1378-1400. **PIRANESI**, *De Romanorum Magnificentia*, fol., Rome, 1761, shows two examples, from the villas Casali and Giustiniani, of an eagle forming part of a capital; and one from S. Paolo fuori le Mura, in which the wing only is so employed; besides a good illustration, on the title-page, of the eagle represented (the size of life) with expanded wings, holding the thunder-bolt, and enclosed by a wreath of oak, being a basso-relievo said to have been found near the basilica Ulpia, and now preserved in the portico of the church of the Apostles at Rome. The eagle of S. John; another on a corner of the parapet to the front of Notre Dame at Paris; and the 'spread eagle', of mediæval heraldry, displayed on a plane surface, are shown in **VIOLLET LE DUC**, *Dict.*, s. v. *animaux*, *corniche*, and *carreau*. **SMITH**, *Dict. Ant.*, s. v. *sceptrum*, *signa*; **CHAZOT**, *De la gloire de l'aigle*, emblème, symbole, enseigne militaire, et décoration, 8vo., Paris, 1849; **ALBERTOLLI**, *Miscell.*, pt. 3, fol., Milan, 1796; **DURAND**, *Parall.*, fol., Paris, 18—, pl. 75.

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EARO

EAGLE (Gr. *ἀετός*). This word has been used by a few writers for a pediment, apparently because **PAUSANIAS**, *Attica*, xxiv, has *AETOS* for the tympanum of the Parthenon. 2.

EAGLE DESK, see **LECTERN** and **PULPIT**.

EANBALD, see **YORK**.

EANES, **ANES**, or **ANNES** (**DOMINGOS**) was erecting buildings at Porto, in Portugal, for Alphonso IV, 1325-40. 88.

EANES, **ANES**, or **ANNES** (**AFONSO**, **GONÇALO**, and **RODRIGO**) were the conjoint architects to whom, as among the most famous in their art, the constable Pereira confided the works, executed during the first half of the fifteenth century, to the monastery of the Carmo (Nossa Senhora do Vencimento) founded 1389 at Lisbon. **RACZYNSKI**, *Dic. Art.*, 8vo., Paris, 1847, s. n., notices that per day the architects received about fifteen shillings, the artificers about six shillings and sixpence, and the labourers about five shillings of present money, according to the price of corn at the two periods. This Rodrigo was perhaps the same as the Rodrigo who was master of the works in stone of the town of Santarem between 1438 and 1477. 88.

EANES, **ANES**, or **ANNES** (**PEDRO**) was master of the works at Ceuta, Alcacar, Tanger, and Arzilla in Africa, 5 Sept. 1473. 88.

EANES, **ANES**, or **ANNES** (**MARTEM**) obtained the place of master of the royal works at Santarem in 1477, had the office confirmed to him in 1496, became master of the royal works at Lisbon, and was in 1504 so aged that Pedro Nunes was nominated his deputy whenever his infirmities required the assistance of another architect. 88.

EAR. This term has been given to two very different portions of architectural decoration. It sometimes signifies, like the Fr. *oreille*, *oreillon*, *orillon*, Ger. *ohr*, the **ACROTIERIUM**, sometimes called the horn, of an altar, of a stele, of a tomb, and the like; in which case workmen know it under different forms, as A, ass's ear; B, cat's ear; C, dog's ear; and D, lion's ear; E, is a modern form.

The same word (Fr. *crossette*, and *oreille*, *oreillon*, or *orillon*; Ger. *eckzierath*, *eckzierde*, *verkröpfung*) has been used for the returns, of the architrave molding round the end of the lintel of an opening, which have been called also in England *ancones*, *croisettes*, *crossettes*, *crossettes*, elbows, horns, knees, prothyrides, and shoulders.

EAR OF DIONYSIUS. The name, which seems to have been suggested by Michel Agnolo Caravaggio, given to a passage or rather grotto, about 187 ft. long, 17 ft. 4 ins. wide, and 64 ft. high (**SMYTH**, *Sicily*), excavated in the northwest

corner of the latomæ or quarries at Neapolis near Syracuse. The least motion of the air is said to cause a strong vibration, overrated by MONTAGU (earl of Sandwich), *Voyage*, 4to., London, 1799, p. 22. A view and plan are given in GOLDICUTT, *Antiquities of Sicily*, fol., London, 1819, pl. 24-8.

EARLY ENGLISH, GOTHIC, or POINTED, ARCHITECTURE, the *Gothic Saxon* of WARTON, (included with Decorated in the) *Complete Gothic* of WHEWELL, *English* of BRITTON, *Early English* of MILLERS and of RICKMAN, *First Pointed* of the ECCLESIOLOGICAL late CAMBRIDGE CAMDEN SOCIETY, *Lancet Arch Gothic* or *Early English* of DALLAWAY, *First Order* of MILNER, *Second Period* of REPTON; (Fr. *Style ogival primitif* of DE CAUMONT; also called *Gothique à Lancettes*; Ger. *Früh* (or *Streng*) *Germanischer* (or *Spitzbogen*) *Stil*). The style of Pointed Architecture which may have commenced in England before 1189 and may have lasted until 1307, but which is better explained as having succeeded here to the Romanesque style towards the end of the twelfth century, and to have changed into the Second Pointed or Decorated style before the end of the thirteenth century, *i.e.* about 1277; ARCHEOLOGICAL INSTITUTE *Journal*, ii, 137. The distinctions between this style and the Decorated, which have been so carefully observed in England, are considered less applicable on the rest of the continent than in Germany: a building carried by slow degrees to completion has frequently, both in France and Italy, no apparent variation to adapt the forms to the style of the day in which they were executed; indeed forms that were common at a very early period of modern art were continued for a long period in some particular buildings in France, and in whole districts in Italy.

In consequence of a lingering use of the term 'lancet', it should be observed that not only on the Continent, but in England, lancet arches were used after the period of this style; and that the openings belonging to First Pointed work were by no means always lancet-shaped, or even pointed at all. Passing as uncommon the pointed horse-shoe arches in the choir at Canterbury, it may be said that Early English openings were sometimes equilateral pointed, and sometimes nearly semicircular; pointed segmental arches occur, and even drop arches; as well as the square-headed trefoil, *i.e.* the straight top with a corbelled and foiled haunch which, in the north of England, occurs also in later work. Trefoiled and cinquefoiled arches, as well as trefoiled and cinquefoiled featherings, were used; the points of the latter being finished generally with balls, roses, or some other projecting ornament. Large circular windows were more used than during the succeeding periods in this country, while abroad they were retained as cherished forms in those styles: smaller circular or polygonal openings were common, with three, four, six, or eight foils, which had frequently no decoration to the cusps; and these openings were often enclosed in a square, a circle, a polygon, or a spherical triangle of circumscribing moldings.

The style is best recognized in England by its moldings and its foliage. The earlier moldings were simply the square reveals of the preceding style worked with large rolls or bolts and deep hollows: the depth of these hollows is so great (a feature not observable in any other phase of Pointed Art), that where horizontal, as in the bases of pillars, they would hold any fluid matter. The beauty of alternated sharp cutting lines, half tints, and shadows graduating into high lights, won steadily upon the artists; and in the later examples are found most beautifully arranged series of hollows, fillets and rolls, vigorous and bold to a degree, refined in the extreme, apparently complicated and yet arranged on the most simple principles. Such combinations of moldings often occur in groups divided by bands of foliage, or by the ornament called the DOG-TOOTH.

Another characteristic of the style is the slender shaft, sometimes single, sometimes grouped round a pier or in a jamb, more frequently detached in this than in subsequent styles, and occasionally banded, which was generally made of Forest,

Petworth, or Purbeck marble. The larger pillars often consist of a pier surrounded by four, eight, or more shafts, having capitals and bases that run into those of the central pier. The plain octagonal, sometimes polygonal, pillar with a capital formed of very simple moldings, carrying a plain chamfered arch, is common to this period; in general the capitals and bases have character sufficiently marked to determine the date except during the transition from this to the succeeding or Decorated style. The capitals consist of small moldings, or display widely spreading masses of the conventional foliage peculiar to this style in England. The ground of all foliated decoration is either considerably sunk, or the ornament is completely undercut and without support except at the extremities: scrolls of such foliage were not uncommon: the conventional character above named does not seem to have been fully preserved in the CHEQUER, commonly called DIAPER, work, which was seldom practised to so large an extent as in this style; nor in any of the continental work, which in Germany however has foliage of its own.

At Exeter cathedral, about the time of bishop Marshall, 1194-1206, or early in the thirteenth century, must have been executed the stall work of the choir, of which the misereres, the earliest and finest in the kingdom, yet remain in excellent preservation. There are fifty-one in all, and they form a collection of early carving hardly to be equalled, and certainly not to be surpassed by any in the kingdom.

Very plain doors of this period are not easily recognized from those of the style that succeeded it. The richer ones, when single, are easily known by their columnar shafts, which were often banded, and frequently carried an abacus or an impost formed by the prolongation of a dripstone or other horizontal stringcourse. In large portals the doorway is frequently divided, and the head between the two apertures and the enclosing arch was made extremely rich (in France and at Higham Ferrers, Northamptonshire, by sculpture over flat-headed doors; generally however) in England by open work tending to tracery: in such cases, as the doors were usually deeply recessed, the jambs had three or four insulated edge-shafts. The windows, until late in the period, were detached lancet lights, sometimes combined in two, three, or more lights, but in almost all windows of three or five lights, the central one is higher than the others. The foliations that are seen in windows belonging to the earlier examples of this style in England are not generally cut out of the same stone as the head of the arch to which they belong, but form the tracery in small pieces, and these enter into the class of PLATE TRACERY, *i.e.* they belong to the flat soffit and not, like bar-tracery, to the outer moldings.

Boldly projecting buttresses with watertables, chamfered edges and gables which, when they occurred at corners, were generally a continuation of the lines of the walls; cornices that, however rich, seldom had their large hollows decorated, but often had below the moldings a corbel table formed by small arches; wooden roofs generally with tie-beams, and when finished, with either canted or barrelled ceilings; massy internal stringcourses; complicated plinth moldings; steeply pointed gables; plain octangular pinnacles; bell cots and bell gables; with short-proportioned broaches, count amongst the distinctive marks of this portion of Pointed Art; RICKMAN, *Attempt*, etc., 8vo., London, 1848, 5th edition by Parker, enters minutely into the characteristics of all the details of this period in England. VAULT.

The best examples of this style are comprised in the galilee to the cathedral at Ely finished 1215, five years before the commencement of the cathedral at Salisbury; the chapter houses at Chester, Lincoln, Lichfield, and Oxford; the nave and transepts of Wells, the nave of Lincoln, the transepts of York, the east end of Hereford, with the west end of Peterborough, cathedrals; the minster at Beverley; the original portions of the transepts at Westminster abbey church; the

chapel at Kirkland; and the ruins of the monastic buildings at Byland, Tynemouth, Valle Crucis, and Whitby: while amongst the most perfect examples of village and other churches may be named, either in whole or in part, those of Ashbourne, co. Derby; Ottery S. Mary, co. Devon; Darlington and Hartlepool, co. Durham; Berkeley, co. Gloucester; Dore abbey, co. Hereford; Eastry, Hawkinge, Postling, and Stockbury, in Kent; Bottesford, co. Lincoln; Raunds, Strixton, and Warrington, co. Northampton; Ovingham in Northumberland; S. Giles at Oxford; Acton Burnel, co. Salop; Abinger in Surrey; Clymping, Edburton, Portslade, Preston, New Shoreham, and Thakeham, in Sussex; Temple Balsall, co. Warwick; Potterne, co. Wilts; Ripple, co. Worcester, with clearstory windows over the piers as at Overbury, north and south doorways, as well as a semicircular-headed north entrance having over its porch a room that appears to have extended over the aisle; with Hedon, Nun-Monkton, and Skelton, co. York.

With regard to the difference between the buildings of France and England in the thirteenth century, a controversy in the *BUILDER Journal*, 1859, pp. 5, 23, 45, and 60, contains interesting passages, inclusive of the statement by one of the writers that VIOLLET LE DUC considers that "although the English rule in the north and west of France appeared to be, politically speaking, well assured, yet there is not a single building in the conquered countries which recalls the architecture of England"; and the writer adds as a corollary that "there is not one building in England which affords any evidence of imitation of any of the distinct features of the architecture of Anjou, Poitou, or Touraine; it is impossible to say the same of the architecture of Normandy, or the old Domaine Royale, since the former is almost identical with our English style, and from the latter the great architect of part of Canterbury cathedral came with his French style to plant it, as it were, on this side of the Channel." WHEWELL, *Architectural Notes*, 8vo., Cambridge, 1842, p. 232, speaks of this French Art as one which differs from Early English in some respects, by the retention of Romanesque members, as the square abacus; in others by the anticipation of Decorated features, as geometric tracery: and he also classes it with that phase of Early Gothic that in Germany as in France takes the place of Early Pointed architecture, which in its pure English form is not commonly found in those countries. PARKER, editing RICKMAN as above cited, and speaking only of Normandy, says that of the pure Early French buildings two are so very excellent that they deserve special mention: one is the church of Norrey near Caen; the other, the chapel of the seminaire at Bayeux: he adds that it may be well to remark that the nailhead and toothed ornaments, though found in France, are by no means so abundant as in England; there is, however, a great similarity in the style of carving at the same date in both countries. The great difference between the Early English and Early French style, is in the system of moldings; the complicated arrangement which, sometimes carried to an extreme, obtains in the former, has been already alluded to: in the latter there is rarely more molding than a simple bead up the edge of the square reveal; the foliated capitals are also more simple, both in foliage and molding; and it should be observed that in exquisite refinement, vigour, and science of molding, the French is very inferior to the English architecture of this date, though in other points its equal.

In France, however, the architects have not yet fully recognized the difference of detail which has been so successfully examined in England; it has been thought by them enough to say that the French Second Pointed preserves all the elements of the preceding style, altered only by wider and bolder arches (except of course in the *cherets*) and by richness of ornamentation. Perhaps, in the way of classification, more has been done for France by INKERSLEY, *Romanesque and Pointed Architecture*, 8vo., London, 1850, than by archæologists of that

country: he demands so early a date as 1163 for the commencement of Early French Pointed Art, in which style he includes chronologically great part of Notre Dame at Paris; the eastern portion of Notre Dame at Châlons sur Marne, 1183; the nave at Fécamp, 1189-1219; the cathedral at Soissons, finished 1212; the church (formerly cathedral) of S. Pierre at Lisieux; the cathedral at Amiens, more advanced, WHEWELL says, than Salisbury; and part of that at Reims: he demands (and is supported in the *ECCLESIOLOGIST Journal*, 1846, vi, 125) 1250 as the date of transition, and includes no building later than 1266, at which he places the church of S. Urbain at Troyes in an unmixed Second Pointed style: and he does not mention the cathedral at Laon, nor that of S. Lucius at Coire, which is pronounced by STREET, *Brick and Marble*, etc., 8vo., London, 1855, who gives an internal view, as belonging to the very earliest Pointed work, and good of its kind. To this list BOURASSÉ, *Cathédrales de France*, 8vo., Tours, 1848, adds the cathedral at Albi; the choir and apse at Bayeux; Beauvais; the nave and aisle at Bourges; the windows over the seven bays of the Romanesque nave at Bordeaux; Chartres; the choir and apse at Clermont; the choir, apse, and transept at Coutances; Dijon; the tower and spire at Fréjus; the upper part of the apse at Limoges; the upper windows of the choir at Lyon; the choir and apse at Le Mans, Tours, and Troyes; parts of the nave at Meaux, Toulouse, Metz, and Poitiers; the nave at Nevers; the apse, etc., at Orleans, and Quimper; Rouen; almost the whole of Sens; and great part of Strasbourg, which is Early Decorated work according to WHEWELL.

Specimens in Belgium are rare, but there exist the church of Pamele at Audenaerde, and the nave of the abbey church at Villers near Genappe, which are the first and second best types of it; parts of the cathedral (S. Paul) at Liège, as well as of S. Gudule, and of Notre Dame (called la chapelle) at Brussels; the porch of S. Servais at Maestricht; the tower of Notre Dame at Bruges, 1230-97; the Dominicans at Louvain, 1230-50; the choir of S. Leonard at Leau, 1237; the Dominicans at Gand, and Notre Dame at Tongres, 1240; the churches of Notre Dame at Diest, 1253, and at Dinant; the front of that commenced 1311 at Huy; all that was erected of Ste. Walburge at Furnes; the church of S. Martin (formerly cathedral), 1254-66, the halle aux draps now the town-hall, and the maison des Templiers, with the lower part of the boucherie, at Ypres; the choir of the cathedral, and the beffroi, at Tournai; and part of the town-hall (afterwards boucherie) at Alost, with one or two houses, late in the style, at Ypres, and as many, with the hôpital de la Byloque, at Gand.

Among the best examples of work executed in the thirteenth century in Germany, besides the Elisabeth-kirche at Marburg, 1235-83, which is perhaps the finest of its class, may be instanced somewhat chronologically, the cathedral at Limburg on the Lahn, said by some writers to have been finished 1058, but by others 1190-1210, the church at Ruffach, with the choir of the cathedral at Wetzlar, and a great portion of the cathedral, 1208-74, at Magdeburg; the Liebfrauen-kirche, 1227-44, at Trier; the choir, 1229, of the Regiswinden-kirche at Lauffen; the kloster-kirche, 1230, at Guldernstern near Mühlberg on the Elbe; the choir, 1235, of the Afra-kirche at Meissen; a great portion of the cathedral, 1237-76, at Halberstadt; the kloster-kirche at Haina, 1238; the choir, 1255-65, of the Cistercian church at Altenberg near Cologne; the Minorite church, 1260, in that city; the stifts-kirche, 1262-78, at Wimpfen in Thal; the choir, 1263, of the collegiate church at Xanten; the kloster-kirche, 1267, at Altenberg on the Lahn; the choir, 1274, of the cathedral at Meissen; the Dominican church, 1274-7, and the choir, 1275-80, of the cathedral at Ratisbon; the stifts-kirche, 1276, at Kyllburg; and the old parr-kirche at Ratisbon, which is variously dated 1250-63, or 1290-1300 (it must be observed that this difference of half a century applies to the dates given by the best writers to many of

the German buildings); till the Transitional style, 1287, of the west side of the cathedral at Agram. Dates cannot be well assigned at all to the choir at Breslau, and the western choir at Naumburg; or to the churches at Marienstadt, Nieburg on the Saale, Offenbach on the Glan, and Tholey, which are four of the best edifices for students of this style; those at Rheinsagen near Güstrow, and Stadtberg; the Marien-kirche at Anclam, the Blasius-kirche at Muhlhausen, the fine kloster-kirche at Neuendorf in the Altmark, the Clara-kloster at Weissenfels, and the church of the Barefooted Friars at Zerbst, deserve attention.

In southern Italy there are still existing the cathedral and its cloister at Cefalu, 1132; the tower, and church finished 1143 of la Martorana, and the cathedral at Palermo, 1170-85; the church at Maniace, 1174; the cathedral at Monreale, 1177; besides the cloister at Monreale, and the Hall of Maniaces at Syracuse; and it must be allowed that Pointed Art made a strong effort to establish itself in northern Italy, as may be seen in S. Andrea at Vercelli, 1219, S. Giovanni in Monte, 1221, and other churches at Bologna; at Assisi, especially S. Francesco, 1228; S. Antonio, 1231, the capella dell' Arena, about 1300, and S. Pantaleone (Sta. Maria del Carmine) at Padua; as well as in the main portion of the brolettos at Bergamo, Brescia, and Como; many monuments, especially that of Cangrande I; the cloister of S. Zenone, and the church of Sta. Anastasia, at Verona; parts of the cathedral, and of the palazzo dei Giuriconsulti, at Cremona; Sta. Maria della Pieve, the church of the Dominicans, and the cathedral, 1256-90, at Arezzo; some of the churches at Genoa; Sta. Maria Novella, 1278-1307, and Sta. Croce, 1285, at Florence; and even the dual palace at Mantua, 1302; the palazzo del Governo at Siena, begun 1287; the front of S. Ciriaco (the cathedral) at Ancona; some of the churches at Venice; and in the cathedrals at Ferrara (west front), Siena, 1284-90, Orvieto, 1290, and Pisa. In the last named city is the church of Sta. Caterina, with the upper arches of Pointed work (? 1253), but the details in general are Italian; a criticism which applies not only to those of the church of Sta. Maria della Spina (built 1230, enlarged and enriched 1300 or 1323), the most Gothic looking building in Pisa, but to those of every other edifice of the sort in that part of Europe.

EARNULPH or ERNULPH, see ROCHESTER.

EARTH. In chemistry, earths are considered to be the oxides of metallic bases, some of which are alkaline and some acid; but these combinations occur so rarely indeed under the ordinary circumstances of architectural practice, that their detailed examination may, without much inconvenience, be left to the chemist and the mineralogist. For the present purpose it may suffice to say that lime, strontian, baryta, magnesia, etc., are good instances of alkaline earths; that the siliceous earths contain a notable proportion of the peculiar silicic acid; and that the clays, glucine, zircon, etc., are earths whose basic properties are less easily defined.

Technically, earths are understood to be natural soils of a yielding, homogeneous nature, which may be removed without the use of the pick. The French military engineers, however, apply the word 'earth' to all the materials in which excavations are carried on; and they make a distinction between the various descriptions of earth according to the number of men required to execute a particular description of work in them. Thus ground which is easily moved is called 'an earth requiring one man' (*terre à un homme*); if two men are required, or one to get and one to fill, the ground is said 'to require two men' (*terre à deux hommes*); and if two men are required to get and one to fill, the ground is said 'to require three men' (*terre à trois hommes*). English engineers only establish a difference between earths and rocks, and they affix the price for each nature of the subject according to its actual value at the particular spot.

EARTH BOUND. A term applied, when constructed

shafts are being sunk into their place, to the constricted condition to which they are sometimes reduced either by settlement of the surrounding ground, or by the aggregation of particles detached by various causes from the face of the excavation: thus the Rotherhithe shaft, 50 ft. in diameter, of the Thames Tunnel, became earth bound when it reached a depth of 40 ft., so that the remaining necessary depth could only be gained by underpinning; the Wapping shaft was therefore made 55 ft. in diameter at bottom, but 53 ft. at top; an expedient which was successful.

EARTH BUILDING. A patent was granted 20 February 1813, to Joseph Hamilton, for certain methods of constructing and connecting earthen building materials, consisting of lumps, bricks, or masses, perforated with holes to receive pins or bolts to fasten them, with or without mortar or cement, the former being always preferable, the most important parts being vitrified together by means of moveable furnaces; REPERTORY OF ARTS, etc., 8vo., London, 1815, 2d series, xxvi, 267. CLAY WALLING. COB WALLING. FURNARIUM OPUS. Pisé.

EARTHENWARE. The class of CERAMIC materials which are the most commonly used in architectural operations, in addition to those herein described under BRICK, CERAMICS, STONEWARE, TILES, are the pottery goods, such as drain pipes, chimney linings, hollow pots, and arch-bricks. All these are obtained from the ordinary descriptions of marls; and, in contradistinction to the ordinary method of brick making, they are invariably burnt in close kilns; they differ likewise from potters' ware on account of the absence of any glaze or colour, unless in very extraordinary cases.

The clays which are adapted for the purposes above cited, are those which are of tenacious uniform texture; free from stones, pyrites, or vegetable remains; rather stiff than otherwise, and with only small quantities of sand or of carbonate of lime. A certain proportion of the hydrous oxide of iron is by no means objectionable; but, after all, the mechanical texture of the clay is the most important condition; it must be such as to admit of considerable pressure during the operation of molding, and of retaining the forms thus impressed upon it, until the burning shall have been completed.

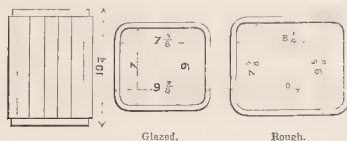
Drain pipes are made in enormous numbers at the present day, for agricultural purposes, by means of a simple description of machinery wherein the earth is forced by a plunger through the die-plates fixed at the end of a cylinder. Great pains are taken, it may be observed, in tempering and purging the clay, and in passing it through the pugmill, or, as in some parts of Nottinghamshire, through edge rollers. The molding machinery may either have an intermittent or a constant action. The so called Ainslie machines are examples of the first class of machines, and in remote situations where the demand is not great it is perhaps the most advantageous, on account of its low cost; but the very soft state in which it is necessary to use the clay, and the almost inevitably consequent deformations which take place in the manufactured articles during the process of drying and burning, constitute serious objections to these machines. Scragg's pipe making machine is a very good instance of the class which have a constant action; the quality of the goods it furnishes is considered to be superior to those supplied by the intermittent machinery. A good Scragg's pipe making machine will turn out as many as 20,000 pipes, of 1 in. in diameter and 1 ft. long, in a day of ten hours work. Whatever description of machinery may be adopted, however, it appears that ordinary tile earth is hardly adapted to the manufacture of pipes of more than 6 or 8 ins. in diameter. Tile drains are almost invariably made by hand.

Earthenware DRAINS are, it must be observed, only applicable to land drainage, or to such places as may furnish a tolerably clear and pure water. Practically they are both absorbent and permeable; so that if used for sewerage purposes they would rapidly become foul, and charged with the elements of con-

tamination of the air they might convey. For sewerage pipes none but stoneware manufacture should be used. *Report to the Commissioners of City Sewers, by HAYWOOD, On the Aylesford Pipe Drains*, is given in the *BUILDING NEWS Journal*, 1856, ii, 419.

Earthen pipes of from 1 to 2 ins. diameter are made only 1 ft. in length; beyond 2 ins. diameter the length is 2 ft. The smaller pipes are made truly cylindrical, that is to say they have no socket ends; but the larger ones are occasionally made with sockets or with butt joints. When the butt joint pipes are employed, they are often connected by means of collars, especially in the submain (or even in the main) drains of a system, wherein the function of the pipes is rather that of carrying off the water than of collecting it.

In the neighbourhood of Håvre a very satisfactory description of earthenware pipe is made for the purpose of forming the lining of chimneys, in walls frequently executed in pisé, or in rubble masonry of the commonest descriptions. Some are glazed, and do not easily allow the deposition of soot. The



outside both of the glazed and of the natural faced tubes is scored to give a key to the mortar, and the heading joints are alternately made with what are called 'spigot and faucet joints' on the same pipe.

The hollow bricks and tiles used for arched ceilings, vaults, etc., have been made of almost every imaginable shape or form. The celebrated dome of S. Vitale of Ravenna is one of the earliest perfect illustrations of this application of earthenware; and some of the most successful works of the kind are to be seen in the stores of the entrepôt des Vins at Paris, and in the Chamber of Deputies in that capital. Very full details of the pots, and of the iron work, employed in the latter instances, are to be found in ECK, *Traité de Construction en Poterie et Fer*, fol., Paris, 1841; and a condensed description of the dome of the church at Ravenna, is contained in RONDELET, *Art de Bâtir*, 4to. and fol., Paris, 1852, 10th edit. Pots.

There are some manifest advantages in the use of hollow bricks or pots for floors, roofs, or partitions, which make it a matter of regret that they are not more frequently applied. In the first place, they admit of fire proof construction with considerable economy, because from their comparatively small weight they do not require points of support of such a mass as would be required in the case of more solid materials. In the second place, they are more impermeable to sound, and they are less diathermal, than ordinary bricks; whilst in the construction of floors for hot-houses, halls, etc., it would be easy to adapt the pots to the transmission of heat, after the manner of the ancient Roman hypocaust. The successful use of these materials, it must however be observed, depends mainly upon the adhesion of the mortars or cements with which they are used; and their employment would therefore be dangerous in situations exposed to vibratory actions. Hollow arched bricks pierced from end to end have been suggested for fire proof floors; but as, if traversed by the tie-rods, they would only bear upon one another at their thin edges, it is not possible to make the arches of sufficient strength to support a very heavy load.

G. R. B.

EARTH HOUSE, see PIER'S HOUSE.

EARTH TABLE. This, which seems to be identical with *grass table*, from a gloss in the MS. Itinerary of William of Worcester, is the GROUND-TABLE-STONE of other writers.

EARTHWORK. The term usually applied in architectural and engineering accounts to the removal of the ground on which buildings are to be erected, or which may be required for the purpose of altering the levels of terraces, approaches,

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roads, etc. In this sense earthworks may be divided into those connected, firstly, with excavation; secondly, with embankment.

In the performance of ordinary excavation, when there is little danger to be apprehended from the infiltration of water, or from the lateral displacement of the soil, the only observations which require to be made are, that the ground must be either thrown out so as to leave a slope depending upon the nature of the material, or must be strutted if the excavation is carried to a great depth. As a general rule, the workmen of any particular locality are the best authorities with respect to the precautions to be taken in the cases above suggested; but when the excavations are carried to any great depth, and especially when they are intended to remain permanently open, greater care is required. As almost every material has its natural stable slope or angle of repose, it is necessary to dress the face of the excavation accordingly, if the face is desired to remain. Rock cutting, such as whinstone, marble, hard lime, or sandstone, will stand vertically; but soft limestones, such as chalk, etc., in the course of time assume a slope of about 0.75 base to 1.00 in height. Sand and gravel, of a compact, imperfectly agglutinated nature, will sometimes stand with a slope of as little as 0.50 to 1.00; but as a general rule it is safer to leave gravel with a slope of 1 to 1, and loamy sand with a slope of 1½ horizontal to 1 vertical. The dark blue clays of the Gault, Oxford, and London clay series, require a slope of at least 2 to 1, even when they are not interspersed with layers of sand; but if the latter should occur in any marked proportion, these clays will hardly stand with a slope of as much as 10 to 1. The red brick clays will support slopes of 1½ to 1. **SLOPE.**

The most essential precaution to be observed in forming excavations in ordinary earths is to insure the perfect drainage of the upper ground, so as to prevent the infiltration of water to any friable beds which may exist in the mass of the strata. This is a very frequent source of trouble and expense in the clay formations; and in them it is necessary to form intercepting drains at the top of the cutting, (to provide an outlet for any waters which may filter into the ground) by means of headings filled in with a permeable material, by pipe drains, or by absorbing wells. In deep cuttings movements do not display themselves in a serious manner until three or four years after their execution; whilst in embankments the movements take place within a very few months, if proper precautions have not been taken with their seating and consolidation as the work proceeds. The Italian, Austrian, and French, military engineers take much more pains with their embankments than the English civil engineers, who never pun the earth except in slips and to repair accidents.

In executing heavy embankments, indeed, care must be taken to insure that the ground upon which they are to be carried should not be liable to compression, or to lateral displacement, under the effects of the superincumbent weight. A failure of this description is by no means rare in alluvial districts; and in such situations it may often be desirable to isolate the action of the said superincumbent weight by means of sheet piling, or by a trench cut through the softer subjacent strata, and subsequently filled in with sand or similar material, so as to cause the compression to take place vertically. Ordinary embankments, if executed in the usual style of railway work, by simply throwing the materials from waggons over what is called a 'flying tip', will sink very seriously during the first year; but if executed by successive layers, each of which has been well 'punned' or rammed, there will be little subsidence. As a general rule embankments may be dressed with a slope of 1½ to 1.

The earth taken out of an excavation, and carried to bank, will occupy a larger space than in its undisturbed position: the increase varying from ½ to ¾ of the original bulk.

It is usual to employ barrows for removing earth to a distance beyond that to which a man can throw it. This is done in runs or lengths of 30 yards for a first run, and 25 yards for each

C

subsequent run. Each workman having wheeled his barrow that length sets it down, and returns with the one the workman before him has just brought back empty. If there should be much rise in the ground the runs are shortened in proportion. If very steep a horse is frequently attached to the front of the barrow, who in effect does the work, the man merely balancing the barrow and keeping it steady on the plank. If beyond 100 yards, or four runs, it is cheaper to employ light tumbril carts, or as the navigators call them 'dobbin carts': and if beyond a quarter of a mile to lay down trams, or a railroad of light metals. If the lead should exceed a mile, and the quantity of earth to be removed be considerable, it may even be advantageous to employ locomotive steam power. In wheeling earth it is calculated that an incline of 1 in 10 of the barrow road increases the labour to such an extent as to justify an increase of price equivalent to one-third of the net value of the transport alone when effected on the level.

A table is appended of the weights of the ordinary descriptions of earth, and of the prices usually paid for getting and filling them; the price of transport must vary with the distance. It is, however, to be observed that in towns, and in house building generally, ordinary engineering prices will hardly apply; because the distance the earth has to be carried to the 'shoot' may modify the cost of such works in a very serious manner.

Amongst the most remarkable excavations recently executed may be cited those of the Tring cutting, on the North Western Railway, cubing about one and a half million yards; of the Gadelbach cutting, on the Ulm and Ausburg line, of about one and a third million yards. The most remarkable embankment upon record is the one upon the Ausburg and Lindau line of railway near Oberhäuser, which contains more than two and a half million cubic yards of earthwork. EXCAVATION.

Table of Weights and of the Quantities of the various descriptions of Earth a workman can get and fill, with the Prices usually paid for that description of labour.

Description.	Weight per yd. cube	Quantity a man can raise and load in 10 min.	Price per yd. cube incld. discharge and dressing.
Harth can't - -	1155 to 1660	Abt. 2	24
Garden earth, or mold	1100 " 1450	" 2	31
Peat { dry - - -	800 " -	" 14	6
wet - - -	1100 " -	" 14	6
Gravelly earth - -	2284 " 2350	" 14	6 with pump.
Mud, with water - -	2000 " 2842	" 14	3½ [ing.]
Clay - - -	2850 " 3000	" 18	3½
dry - - -	2450 " 2460	" 2	3
Sand { dry - - -	2875 " 3100	" 12	3
wet, river - -	2975 " 315	" 12	3
Shingle - - -	3000 " 3000	" 1	44
Chalk - - -	3000 " 3000	" 1	3
soft - - -	3000 " 3000	" 1	3
very hard - -	4000 " 4000	" 1	9 to 111.
Trap rocks - - -	4850 " 4850	" 1	54 to 10d.
Granites - - -	4700 " 5170	" 1	11 to 1s. 2d.

For slight operations of earthwork, such as preparing lawns, etc., it is considered sufficient to (uncallow) take off the turf, and turn the ground two spits and a crumb or 18 to 24 ins. deep before returfing or sowing grass on a proper top dressing. ETZEL, *Notice sur la disposition des grands chantiers de terrassement*, fol. and 4to., Paris, 1859; *ANNALES DES PONTS ET CHAUSSEES*, Nov. and Dec. 1847. G. R. B.

EASEMENT. In addition to the ordinary rights of property, which are determined by the boundaries of a man's own soil, the law recognizes the existence of certain rights, accessory to those general rights, to be exercised over the property of, and therefore imposing a burden upon, a neighbour. These accessory rights are divided into two classes, profits which arise from participation in the fruits of the neighbour's land, as rights of pasture or of digging sand; and easements which are merely conveniences to be exercised over such land without any participation in the profit of it, as rights to the passage of air, light, and water. Both these classes are comprehended under the 'servitudes' of the civil law, which does not draw

the above distinction when treating of prædial servitudes, as rights of driving cattle to water, burning lime, etc. The tenement to which the right is attached and that on which the burden is imposed are respectively known as the dominant and servient; the term 'servitude' is used to express both the right and the obligation; the word 'easement' generally expresses the right only. Affirmative easements are rights of way; of discharging a stream of water either in its natural state or changed in quantity or quality; of discharging rain water by a spout or by projecting eaves; of gaining support from a neighbour's wall; of practising offensive trades; of hanging clothes on lines passing over a neighbour's soil; of burying in a particular vault: negative easements are rights of receiving a flow of water; of receiving light and air through ancient openings; of being supported by the neighbour's soil. Easements may also be divided into the classes of continuous, discontinuous, apparent, and non-apparent. By the English law the origin of rights of this kind is referred either to an express contract between the parties, or to a similar contract implied from their conduct, i. e. from the peculiar relations of the parties at the time they became possessed of their respective tenements, or from the long continued exercise of the right, from which a previous contract between them may be inferred: the present state of the law depends on the act 2 and 3 William IV, cap. 71. The essential qualities and subjects of easements; the acquisition of easements by express or implied grant or by prescription; the legalization of nuisances; the questions arising upon party walls and party fences; the incidents of easements, as the obligation to make repairs, or as secondary easements, as well as the extent and mode of enjoyment; the extinction of easements by release, either express or implied by merger, necessity, or cessation of enjoyment; the disturbance of easements and its remedies, are treated at length by GALE and WHATLEY, *Law of Easements*, 8vo., London, 1849, with special reference to the subjects of rights to water, to light and to air, rights of way, and rights to support from neighbouring soil and houses, either as natural support to land, as support to buildings from adjacent land, or as support to buildings from buildings; and on negligence in law and in fact; with very interesting particulars as to shoring, pulling down, and digging near or draining a neighbour's property. 14.

The various decisions which have been given upon such cases as have arisen since the publication of the above named work, must of course be sought in the various legal Reports, etc. The French law of Servitudes, *Services fonciers*, is given in MIGNARD, *Guide des Constructeurs*, 8vo., Paris, 1847; and in FRÉMY-LIGNEVILLE, *Législation des Bâtimens*, etc., 8vo., Paris, 1848.

EASTER SEPULCHRE, see SEPULCHRE.

EAST INDIA BLACK WOOD, see BLACK WOOD.

EAST INDIA EBONY, see DALBERGIA.

EAST INDIA ROSEWOOD or SIT-SÂL, see DALBERGIA.

EAST INDIA TEAK, see TECTONA.

EASTLAND BOARD. Considerable difficulty attends this term. No authoritative document has been yet found to decide whether it meant boards of oak or of fir. In the *Rotuli Scotiae*, fol., London, 1814, i, p. 542, are the entries of " Duo millia bordarum de Estland quæ vocantur 'waynescot'. Quingenta tigna de firre longitudinis viginti et quatuor pedum, 4 August 1338"; and at p. 556 the same passage occurs except that the word is there spelt 'waynescote'. RAINE, *S. Cuthbert*, 4to., Durham, 1828, p. 155, speaking of Eastland boards as Norway deals, is followed by the SURTEES SOCIETY, *Priory of Finchale*, 8vo., London, 1838, ii, ccccxx, which explains 'centum de bordis de Estland emptis apud Novum Castrum' as boards or timbers from Norway, bought at Newcastle 1307; and cclxxvi, ccccxxviii, 'Estland bordes' as Norway timber, in planks or boards; no reason for these definitions is assigned; and the Report of the Select Committee on Timber Duties, 1835, p. 339, speaks of Eastland, as it was termed, in contra-

distinction to Norway and Sweden: on the contrary, ANDERSON, *Origin of Commerce*, 4to., London, 1787, ii, 148, 389, shows from the charter, 1579, of the Eastland company, etc., that it traded to both sides of the Baltic. Ostrich, Estrich, Eastland, Oster, from Esterych, that is, wainscot, is a definition that has been given. W. P.

There is a tradition that Eastland boards were Dutch wainscots made from the timber of the pollard oak; the Easterlings or Eastlanders being the inhabitants of the Hanse or free towns in the east part of Holland; from whence the name of the present currency in England, the pound *sterling* or Easterling is derived. SKINNER, *Etym.*, s. v. Sterling. A. A.

EASTRY (HENRY OF) or DE ESTRIA, elected 1285 prior of Christchurch at Canterbury, died 1331: according to his Register in 1304-5 were executed the repairs of the chapter house with two new gables, and the repairs of the whole choir with three new doors and a new screen or rood loft (pulpitum); which latter works are described by WILLIS, *Canterbury Cathedral*, 8vo., London, 1845 (on the authority of the obituary of the establishment, saying that he decorated the choir of the church with most beautiful stonework delicately carved), as being the stone enclosure of the choir, the greatest part of which still remains, as well as the western, northern, and southern doors, the present western screen being of a much later period. This screen was brought to light and restored by G. Austin, 1820-48. The window in Anselm's chapel, given in *Builder Journal*, 1845, iii, 476, is ascribed to Eastry by WILLIS, p. 116, although dated 1336 in the Archives printed by BATTELY.

EATING ROOM. It was a common provision in large houses, about the commencement of the nineteenth century, to have a room called by this name where the family took their ordinary meals; the large dining room, or as it was frequently called the BANQUETING ROOM, being only used for great occasions. DINING ROOM. A. A.

EAVES (in old English *eys*; It. *grondajo*, pl. *grondaje*, *grondatojo*, *goccioletajo*; Sp. *socarrén*; Fr. *bord, sêcérone*; Ger. *traufe*). The edge, of a sloping roof, which overhangs the face of a wall so as to let the rain water drip from the roofing material without being drawn up on the under side of the tiles, slates, etc., by capillary attraction. This edge is called a dripping eave when the water is allowed to fall from it, in contradistinction to eaves simply, which would generally imply the existence of a gutter or trough of some sort conducting the water to spouts or pipe-heads. The edge of a roof hanging over the side of a gutter is also called the eaves. In slating, single eaves and double eaves respectively, denote that the roof ends with a single or a double course of slates: in tiling a similar explanation applies to double, triple, etc., eaves.

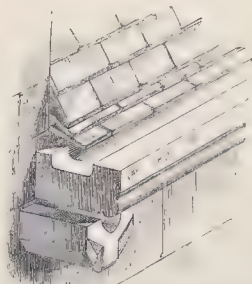
EAVES BOARD or CATCH. The thick feather-edged board, which receives the actually lowest course of tiles or slates, and raises the bottom of it so as to correspond with the slope of the courses above, which are raised by the thickness of the course on which they lay, and allow it to be bedded. BELL CAST; BREAK; CHANTLATE; DOUBLING; EAVES LATH; EAVES POLE; TILTING PIECE.

EAVES CHANNEL.

A channel sunk into the upper course of a wall to catch the drip of the tiles, and convey it to the gargoyles. It is sometimes lined with lead, but in old work is often simply sunk in the stone. A. A.

EAVES GUTTER, see GUTTER.

EAVES LATH. In inferior work, where it is wished to save the expense of a proper eaves board, a



Comp. from VOLT, *Tr. de l'Art de Bâtir*, &c., Chapter, the channel board and lath, showing a section.

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lath of extra strength is used to receive the lowest or eaves course, and is known by this name. ARRIS-FILLET; EAVES-BOARD. A. A.

EAVES POLE. The name given in Manchester to the EAVES CATCH.

EAVES TILE. An invention lately introduced by Beadon, and called by him the 'patent imperishable gutter tile'. It is made of tile earth; forms a good finish; is said to bear the weight of any ladder; to be easily repaired; to be the cheapest kind of spouting; to be applicable to roofs whether thatched, slated, or tiled; and to be easily fixed. Representations of the 'tile', 'stop-end', and 'outlet', are given in advertisements at the end of the year 1857.

EAVES TROUGH. The name given to a sort of gutter that catches the rain as it drips from projecting eaves of a slated or tiled roof, and conveys it into the down-pipes. Such troughs are either of metal or wood. The former are generally made of cast iron or of zinc, and are either half-round or flat against the wall; they are sometimes molded outside, and are fixed at the heading joints with iron brackets, sometimes with ornamented clips, which serve the double purpose of strengthening the joint and of making it water-tight. Wooden (eaves) gutters, which are now going much out of use, are either ARRIS (eaves) GUTTERS, made of two pieces of wood nailed together and fixed with brackets, much as the metal half-round gutters are fixed; or else are box (trough) gutters, made of three pieces of wood in the form of a square trough. If wood gutters are used, they should not only be well painted outside, but should have a good coating of pitch inside. A. A.

Woodruffe's patent suspended eaves trough, given in the *CIVIL ENGINEER Journal*, 1854, xvii, 225, is unfortunately exposed, like all other eaves troughs, to the certainty of damage when a ladder is raised or turned against it.

EBERHARD, see EINSIDLEN (EBERHARD OF).

EBONY. The name generally applied to timber of different species growing in various parts of the East Indies. It is impossible as yet to determine the species, or to verify all the names of the various specimens of ebony. Among them are,

AMERIMNUM ebenus or Cocus wood, now called *Brya ebenus* and green ebony; Jamaica ebony.

BANGRO, or ebony of British Guiana.

BAUHINIA FORATA, or mountain ebony of Jamaica.

BLACK WOOD.

BRYA ebenus of Cuba.

DALBERGIA, East Indian ebony, blackwood, or rosewood of East Indies, called sit-sál, on Malabar coast.

DIOSPYROS, black ebony of commerce, from the Mauritius, etc.

DOMBETA, S. Helena ebony. GREEN EBONY.

The *Bois de Nabh* of Egypt is a hard dark coloured wood resembling ebony.

Red ebony of Natal is a hard, heavy, very close-grained red wood, admirably adapted for turning and the finer sorts of cabinet work, approximating to ivory. This wood appears to be new, and being esteemed a valuable addition to the hard ornamental woods already known, a prize medal was awarded for it at the Exhibition of 1851. 71.

Another red ebony of Western Australia, found near Shark's Bay, is very different from the above. 71.

EBORA or EBURA. The ancient name of EVORA in Portugal.

EBORACUM, see YORK (JOHN OF).

ESAMBUL. The mode adopted in France of writing ABOOSIMBEL.

EBURACUM, see YORK (JOHN OF).

ECBATANA or AGBATANA. The locality to be assigned to this celebrated name has been made uncertain by RAWLINSON, *Memoir on the Site*, in the ROYAL GEOGRAPHICAL SOCIETY *Journal*, 8vo., London, 1841, x, 165, who not only accepts an Ecbatana as the capital of Semiramis and of Arbaces in Lower Media (Media Magna or Southern Media) at Hamadan in Irak, where it is placed by the majority of scholars and travellers; and asserts the existence of another city of the name, about a hundred and fifty miles north of it, as the capital of Deioeces in Upper Media (Northern Media or Atropatene) at

the ruins of Takht-i-Soleiman in the province of Azerbaijan; but considers the probabilities of this name being assigned to other localities by ancient authors. The reasons for these opinions are examined; the position of Ecbatana at Ispahan by WILLIAMS, *Geogr.*, 8vo., London, 1829, is controverted; and the chief historical points relating to the name are given, in SMITH, *Dict. Geog.*, s. v. RAWLINSON, *Herodotus*, 8vo., London, 1858, i, 240.

ECCLESIA (from ἐκκαλέω, to summons, to call together). A congregation or assembly of persons for public purposes, as the ἐκκλησία at Athens; PLINY, *Ep.*, x, 3, says 'et bule et ecclesia consentiente'; and the word is used in this original classic sense in Acts xix, 32, 39-40; S. PAUL also, in several places, employs it for the confederation of the faithful. Perhaps the earliest use of the word for a place for sacred assembly of Christians does not occur before the later part of the second century by CLEMENS ALEXANDRINUS, *Stromateis*, vii. BINGHAM, *Origines*, 8vo., London, 1840, ii, 337, 364, 367, 376-8, shows that the early Christian buildings were called *dominicum* and *κυριακόν* (the Lord's house) as early as the time of Cyprian; that about the time of Ambrose, Jerome, and Sidonius Apollinaris, they were called *basilica* and *ἀνάκτορον*, and not designated as *templum* till very late; he cites from VOPISCUS, *Vit. Aureliani*, "in Christianorum ecclesia non in templo Deorum." The word was not, however, in general use so late as the time of ISIDORUS PELUSIOTES (400-450), as applied to the building itself. **ECCLESIASTERIUM**. A. A.

This word, in the sense of a temple, however, was equivocal originally to a certain extent, as it signified any holy building, whether private or quasi-public, without reference to size, according to CRESCIMBENI, *Storia della Chiesa di S. Giovanni*, 4to., Rome, 1716; and similar information is given in ZACCARIA, *Onomasticon*, 4to., Favenza, 1787; and by MAGRI, *Notizia*, 4to., Venice, 1732, who adds that S. Agobard terms parochial churches *ecclesie nutrices*. BINGHAM, ii, 359, also notes the use of *ecclesia matriz*, 'a mother church', either for a church planted or exhorted immediately by the Apostles; or else for a metropolis or the principal church of a single province; or, as most commonly, for a cathedral or bishop's church, which was usually termed the great church, the Catholic church, the principal see, in opposition to the lesser *tituli* or parish churches committed to single presbyters. The churches in the diocese were the same as those now called parish churches, although they are called in some canons *ecclesie diocesane*. The same author, 343, 362, notices the title of *ecclesia catholica* given to a church where baptism was allowed to be administered. **BASILICA**; **CATHEDRAL**; **CHAPEL**; **CHURCH**.

ECCLESIASTERIUM (Gr. ἐκκλησιαστήριον). A term used by VITRUVIUS, vii, 5, as the name of the very small theatre at Alabanda; and by ISIDORUS PELUSIOTES, ii, *Ep.*, 246, who says, "the church (ἐκκλησία) is one thing, the ecclesiasterium another: one is composed of blameless souls; the other is built of stones and wood." BINGHAM, *Origines*, 8vo., London, 1840, ii, 336, 378. A. A.

ECCLESIASTICAL BUILDINGS. A term applied to all buildings used for, or connected with, ecclesiastical purposes, and so included in one of the branches of civil architecture. Such works also rank in the class of private property: belonging either to a corporation, as in the case of a cathedral church to the dean and chapter; or to the parishioners, as in the case of a parish church (except in most cases in England as regards the churchyard, the chancel, and the parsonage, which are under the control for life of the incumbent); or to a monastery or convent; and to trustees or to individuals, as in the case of chapels abroad and at home.

ECCLESIOLA. The diminutive of **ECCLESIA** as a church; i. e. according to DUCANGE, *Gloss.* s. v.; capella, sacra edicula. It is noticed in BRITTON, *Dict.*, s. n. *ecclesiola*, as "a term of frequent use in Domesday Book, and generally understood to signify a chapel subordinate to the mother church. After

naming the church of 'Tarentefort' in Kent, it is said 'extra hanc sunt adhuc tres ecclesiolæ.' At Postinges, in the same county, two ecclesiolæ occur, without any notice of a church. At Wallope, in Hampshire, the ecclesiola appears to have been also independent of the mother church. At Street, in the county of Sussex, two ecclesiolæ are also named in the same record; yet the population of the manor would scarcely require two distinct places of worship, and it is not unlikely that it meant two altars, or chantries, in the church at Street."

ECCLESIOLOGY. This term was explained by HORÆ, *Present State of Ecclesiological Science in England*, read at the Oxford Architectural Society 1846, as the systematic study of the requirements of Divine Worship; and this definition, however defective by the omission of the words 'as practised by Roman Catholics in the middle ages', was highly praised in the *ECCLESIOLOGIST Journal*, 1847, vii, 85-6, a work which gives, in its reviews, the titles of most books produced since 1842 upon subjects which may be referred to this head.

ECHAVE Y ZABALA (JUAN) was maestro de obras under Ardemans (until 1736) at Aranjuez. 66.

ECHEIUM or **ECHEUM** (Gr. ἑχέϊον, from ἑχέω or ἕχος, meaning sound. This word is used by VITRUVIUS in i, 1, where (by a corruption of the word 'discrimine') it has been supposed to signify an interval or difference of sound; but in v, 5, it is the name given to each of the vases that were placed amongst the audience, in some of the ancient theatres, in order that the voice, pouring from the scena as a centre and diffusing itself, might strike the inside of each vase and so excite an additional clearness and suitable consonance in unison with itself. Such at least is the best rendering of the words "vox ab scena uti ab centro profusa se circumagens tactuque feriens singulorum vasorum cava excitaverit autam claritatem et concentu convenientem sibi consonantiam." He states that these bronze vases were to be so made that, when a set of seven were struck, they might give sounds corresponding to as many notes which he particularises in the previous chapter on musical tones. Cells having been prepared between the seats in the theatre, the vases were to be placed in them so as not to touch any wall, but with a clear space round and over them; being fixed in an inverted position, and having underneath, at the part towards the scena wedges not less than 6 ins. high; opposite the cells, openings each 24 ins. long and 6 ins. wide, were to be left in the seats of the lower steps. For a theatre of moderate size the vases were to suit a harmonic scale, and were to be placed in a range at half the height of the building, in thirteen cells at equal distances from each other: but for a large theatre the height was to be divided into four parts, so as to admit of three ranges of vases, each range suiting a different scale, the lower one being harmonic as before, and the second and third respectively chromatic and diatonic; the proper position for each vase according to its note being noticed in his usual careful manner. The chapter concludes thus: "some one may perchance say that many theatres are built year after year at Rome in which no regard has been paid to these matters. But he would be mistaken, inasmuch as all public theatres constructed of wood have much boarding (quas necesse est sonare), which is a conductor of sound. This might be noticed from singers who when they wish to produce a loud tone turn themselves to the doors of the scena, and receive by their help a consonance to the voice. But when theatres are constructed of solid materials, that is of rubble, squared stone, or marble, which do not sound, the rules in question are to be observed. If it be asked in what theatre they are applied, we cannot produce one at Rome, but such may be seen in provincial towns of Italy, and of many Grecian states. We have also the authority of L. Mummius who, on the destruction of the theatre at Corinth, brought to Rome some of its brazen vases, and dedicated them as spoils at the temple of Luna. Many clever architects, while erecting theatres in small cities, have produced most useful results by selecting, in default

ECCLESIASTICAL SCULPTURE

Fig 1



S. MARCO - VENICE

Fig 2

Metal Painting
S. FERMO - VERONA

Fig 5



Metal Painting S. FERMO VERONA

Fig 2



CAMPO SANTA MARIA DELLA SCALA - P.D.

Fig 3



S. MARCO - VENICE

Fig 4

Elbow of Stall
S. ANTONIO - PADUACanopy S. ANTONIO - PADUA
2nd Floor S.D.A.

of other means, earthen vessels that yielded the proper sounds, and using them in the manner above indicated."

It is curious no other author mentions these vessels; on the contrary, PLINY, lib. xi, cap. 112, considers the voice to be destroyed (devoratur) where sand is scattered, or where there are empty vases (doliis inanibus), as well as by rough walls.

FAULKNER, *Museum*, etc., 8vo., London, 1854, supp., translating Belli's information recorded 1582-96 upon the theatres, etc., in Crete, says that the greater theatre at Hierapytna "had at least one row of bronze echeia, the cells for which are very visible, and indeed the best preserved of any of these theatres. The ignorant inhabitants of the island, who do not know what a theatre was, call these cells *ovens*." At Lyttus "there were three rows of brazen vases (echeia) in this theatre, almost all the cells for which are still visible." His plan of the larger theatre at Gortyna also shows the places of one row of thirteen vases.

This system was not understood, it might be said was not believed, until the publication by the ROYAL IRISH ACADEMY, *Transactions*, 4to., Dublin, 1790, of a paper by CONYNGHAM, *Observations on the Description of the Theatre at Saguntum*, who says, "I observed a particularity which is not taken notice of by the dean" (of Alicante, MARTI, in an essay reprinted by MONTAUCON, *L'Antiquité*, fol., Paris, 1719, iii, 237): "on the top of the principal *præcinctio* there are several grooves cut in the stone, of about 1 ft. 6 ins. broad, placed two and two, at two feet asunder, and alternately between the vomitoria"; and then suggesting that these were to receive the echeia, he adds, "it is to be observed, however, that VITRUVIUS directs thirteen cells at twelve equal distances, but here there are only nine, and it appeared to me that the distances between the grooves were unequal. The skilful in these subjects will decide whether by means of this inequality of distances the nine might not have answered the same purposes as the twelve at equal distances." These recesses are shown in the plan, but not in the section, given by CONYNGHAM.

With regard to the theatre at Scythopolis (Bethsan) in Syria, IRBY and MANGLES, *Travels*, 8vo., London, 1823, p. 302, say that it "has the singularity above all theatres that we have ever seen, viz. that those oval recesses half way up the theatre, mentioned by VITRUVIUS as being constructed to contain the brass sounding-tubes, are found here . . . there are seven of them." But in the supplementary volume to STUART and REVETT, *Antiquities*, fol., London, 1830, iv, DONALDSON, *On the Greek Theatre*, p. 40, states that Mr. W. J. Bankes discovered, at the theatre of Scythopolis, a very complete example of the echeic chambers under the seats, with a gallery of communication affording access to each chamber, for the purpose of arranging and modulating the vases. The last named writer adds that at Nicopolis, in the larger of the two (Roman) theatres, the podium of the central *præcinctio* has eight niches, apparently adapted for the reception of vases, and there are also three wells sunk in the body of the cavea, made probably for the advantage of the sound, on the principle of Aristotle, xi, prob. 8 and 9, noticed by ALBERTI, viii, 7.

TEXIER, *Asie Mineure*, fol., Paris, 1839-49, i, 113, says, with regard to the theatre at Aizani, that the diazoma or supporting wall of the second *præcinctio*, although partly destroyed, showed niches or small cells, in pairs, having thin walls made of a single piece of white marble. He does not perceive the use of these unless for the system of sonorous vases placed in the *præcinctio*. After citing VITRUVIUS, he adds that the arrangements in the theatre in question so far agree with those mentioned by that author, that the pairs of cells are twelve in number, placed in the middle of the height of the building. Having never seen such a contrivance in any other ancient theatre however well preserved, he thinks that VITRUVIUS has mentioned an exception rather than a rule; and he adds that even if the echeia were placed in the niches, they must have had the form of a basin or gong rather than of an urn or an

amphora. The plan and a portion of the elevation of these rectangular cells, which are 3 ft. 6 ins. wide and project 10 ft. 6 ins. from the wall, are given in plates 42-4 of his work.

"Dans le chœur du temple neuf à Strasbourg, autrefois celui d'un monastère de Dominicains, le professeur Oberlin avoit découvert de pareils vases appliqués à différens endroits de la voûte. Les ouvriers en blanchissant il y a quelques années l'intérieur de ce chœur, crurent bien faire, en brisant ces vases de terre cuite qui leur sembloient des hors-d'œuvres inutiles"; MILLIN, *Dict.*, 8vo., Paris, 1806, s. v.

In the Architectural Exhibition (London) 1849, was a design by Mr. Charles Curle "to elucidate the arrangement of the brazen musical vases, as disposed in cells within the seats of the ancient theatrical buildings; and also to exemplify by the modern treble clef the actual note that each vase was intended to reflect."

For the bronze vessels in theatres which imitated thunder, see BRONTEIUM. HESYCHIUS describes *ἡχείων* as the brass work, *χαλκῶμα*, of the instrument called *μάγαδιν*, which some consider the harp of twenty strings, and others the Lydian flute.

ECHELLES (JEAN D'), see CHELLES (JEAN DE).

ECHEVARRIA (DON JAVIER IGNACIO DE), pupil and son-in-law of I. de Ibero, succeeded him 1766 in the superintendence of the erection (from designs made by C. Fontana at Rome) of the Jesuit college and church of S. Ignacio at Loyola in Guipuzcoa. He also constructed the casa de ayuntamiento at Miranda de Ebro; the portal of the parish church at Azpeitia; the high road from Burgos by Somo-Sierra to Madrid; and at the time of his death was directing the supply of water to Echari de Navarra. 66.

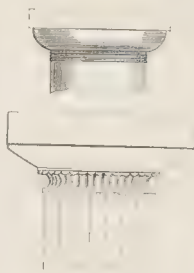
ECHINUS. The Latin word, derived from the Gr. *ἐχῖνος*, which has attained three significations; first, as a particular molding; secondly, as the ornament usually applied to a molding with that profile; and lastly, as a part of the decoration of such enrichment. The idea that the term was employed by the early Greek builders in any of these senses seems to depend with little foundation upon the fact that it is applied by VITRUVIUS (iv, 3) to the bowl of the Doric, and (iv, 7) of the Tuscan capital; in these cases the molding might not be unfairly compared (as suggested by a technical use of *ἐχῖνος* by DEMOSTHENES, ed. Reiske, 8vo., Leipsic, 1775, pp. 999, 1104, 1119, 1143, 1180, 1265, for something, whether of wicker, clay, wood, or metal, is unimportant, in which the documents in judicial proceedings were kept) to a sort of tazza covered with a tile. As regards the authority of VITRUVIUS, it may be observed that there is merely an assumption by common consent that the bowl in his time always had a profile due to a conical or a spherical section; other forms have been employed for such bowls: furthermore, as he does not otherwise anywhere name the molding which is now called ovolo and echinus, it is impossible to say whether he had any name for that molding when used in any other place than a capital: and it may be added that although there is nothing in his words that can be supposed to imply his expectation of the presence of the egg-and-tongue, a general opinion has prevailed that such decoration was a necessary part of the ornament. During several hundred years it has been usual to account for the name given to the undecorated molding, by a belief in the resemblance of the ornament to the rough and prickly shell of the fruit of the chesnut when burst by the ripe fruit.

This belief may be due to BARBARO (*Vitruvius*), fol., Venice, 1567, p. 114, who says "cymatium—sed in capitulo Dorico echinus dicitur quia ea pars echinis castaneorum sculpta cernebatur", and since his time the term has been used for 'ovolo' when a molding of that section is decorated with the egg-and-tongue ornament, whether carved or painted; NEVE, *Dict.* s. v., further says the word is sometimes used to signify the quarter-round, but more commonly that part of it which includes the ovum or egg: BUILDER *Journal*, 1844, ii, 179, 243. 17. 23.

In order to understand the origin of the application of this

term to the simple molding, and to prepare for some of the difficulties which will present themselves *s. v.* EGG AND ANCHOR, it seems necessary to quote the explanations given by HESYCHIUS, *s. v.* ἔχυνος, viz. an island cake (probably from the islands called Echinades); part of the inside of ruminant animals (probably *tripe* from its roughness), and of fowls; a cooking vessel; the κύτταρος of the oak (the cup of the acorn); the fruit of the plane tree (also rough and prickly); part of the capital of a column; part of a bridle (a serrated bit); the angle of a roof; a λωπὰς (which was a plate or dish to eat from, according to ARISTOPHANES, *Vesp.* 511, *Equit.* 1034, and not a χύτρα, although POLLUX, vi, 91, 95, has κύτρας, properly χύτρας, εἶδος, olla species, a sort of earthen pot or pitcher), an eatable marine animal (the prickly-crab or sea-urchin); the form of the waves; a species of mouse; the porcupine. SUIDAS, *s. v.*, however, gives another meaning, "the vessel (ἄρτος) in which the written depositions of the witnesses were placed and sealed up, in case of an appeal against the judge's decision." Among the Latin writers, HORACE, *Serm. I.*, vi, 117, uses 'vilis echinus' for a vessel of some common material: PLINY, *H. N.*, xv, 23, applies the term echinatus to the prickly husk of the chestnut: and CALPURNIUS, *Bucol.*, ii, 83, says 'maturis nucibus virides rumpuntur echini.'

It will be seen that the meanings above given may chiefly be divided into two classes—something rough or prickly, and a species of vessel; and thus some way may have been made towards obviating the confusion between the origin of the name as applied to the molding itself, and to the ornament. That a plain ovolo should obtain its name from the prickly shell and fruit of the chestnut, as has been supposed of the latter, seems impossible; it can only, therefore, be inferred that the Greeks must have taken its name from the rounded shell of the fish; or still more probably, as has been suggested above, from a vessel of some (perhaps) flattish shape; and if a tile were placed on the top, as shewn by the dotted lines, the vessel would exhibit the echinus, its foot the annulets, and the tile the abacus: and in the second figure, from the small temple at Pæstum, there is a still greater resemblance to a tazza with an ornamented foot. EGG AND ANCHOR; OVOLO; QUARTER-ROUND.



A. A.
ECHMIM, ACHMIN, or AKHMIN. The modern name of CHEMMIS or Panopolis in Egypt.

ECHO (Gr. ἦχον, ἦχος, or ἦχον, meaning sound). This word is applied to the audible reverberation, more elegantly called in Latin *imago*, of a sound; and has even been given by some writers to any building, or part of a building, in which this reverberation is produced. Little was done towards the comprehension of the phenomenon from the time of BLANCANUS, *Sphæra Mundi*, fol., Modena, 1635, in the appendix called echemetria (except that SAVOT, *Arch. Fran.*, 8vo., Paris, 1685, teaches that to make an imitation of one at the old garden of the Tuileries a wall 13 ft. high and semicircular on plan, 157 ft. in diameter, was necessary), until the subject was considered by HERSCHEL, *Treatise on Sound*, in ENCYC. METROP., which formed the basis for the article in the PENNY CYCLOPÆDIA. Besides the instances at Louvain, Rouen, Killarney, and Castle Amber co. Kilkenny, given with calculations in STUART, *Dict. s. v.* and other encyclopædias, the following are considered worthy of attention, with the view if possible of suggesting a remedy.

In the *Remarks*, which are added to WHEWELL, *Architectural Notes*, 8vo., Cambridge, 1842, it appears at p. 184, that the two chief stories of the former electoral residence at Coblenz, 1778-88, were restored 1822-4, and converted into courts

of justice. But the old concert room, intended for the public business of the jury court, proved so unfavourable for public speaking, that the voice of the speaker could not be heard unless the hall were quite filled with people. Its dimensions are 92 ft. long, 40 ft. broad, and 46 ft. high. Rooms constructed with wooden cylindrical and spherical vaults often present a similar inconvenience, said De Lassaulx, who caused a large sail cloth to be fixed to the imposts, and thus extended over the hall: and as the annoying echo immediately ceased, a linen tent-like cover slightly painted was so adjusted as to separate the room entirely from the arched ceiling.

The same fault still oftener results from flat ceilings, or large unbroken surfaces of walls. In the new courts at Guildhall, London, this was remedied to a great degree by fixing some large portraits painted on canvas round the rooms. Large flags, or hanging draperies, or curtains, form a still more effective arrangement.

In the ball room of the prince of Prussia's palace at Berlin, there is an echo which replies twenty-four times, and as distinctly as that at Thornbury castle near Bristol; but this effect ceases when about forty persons are present.—The ceiling is domed, with a circular opening and a sky-light; *Builder Journal*, 1853, xi, 663: the effect is most observable to a person standing in the centre. At Adersbach in Bohemia there appears to be an echo which repeats seven syllables three times without any confusion of the sounds; "le centre de ces sons est à une petite distance des côtés du grand cône dans lequel est le principal foyer des sons réfléchis." Words pronounced in a low voice are given distinctly at the requisite distance, but at a few paces from it the loudest voice obtains no echo: LANGLOIS, *Dict. de Geog.*, 8vo., Paris, 1838, s. v.

WOODS, *Letters*, 4to., London, 1828, p. 120, says that in a church (of S. Francesco?) at Ferrara "the nave seems to have been intended to present a series of cupolas, as the side aisles actually do on a smaller scale, but in its present state, at the point where the square is reduced to a circle, a flat ceiling is introduced instead of a cupola. Standing under any one of these, the slightest footstep is repeated a great many times, but so rapidly, that it is difficult to count the reverberations. I reckoned sixteen, but the effect is rather a continued clatter than a succession of distinct sounds." Twenty reverberations, indeed, have been counted; the shape of each bay appears to be a double cube standing on end, *i. e.* about 30 ft. square and 60 ft. high up to the flat or springing of the cupola.

Amongst other echoes in Italy, notice should be taken of that in the palazzo Manfrini at Venice; of that in the royal library at Naples; of the triple echo in the certosa, since made a barrack, in the island of Capri; and of that at the villa Simonetta near Milan, which repeats more than thirty times; but, until the alteration of a wall, repeated thirty-six times.

At Great Oxendon the belfry of the church produces an echo which, formerly, returned distinctly thirteen syllables when uttered by a person standing at the distance of 673 ft. on the western part of the elevated ground on which the church is built; but this effect is now greatly diminished owing to alterations in the belfry windows. There is a remarkable echo at Gloucester in the chapter-house which has been recently restored; it has an encaustic tile floor and a stone semicircular arched ceiling. The echo in the burial place of the earls of Abercorn at Paisley, is described by PENNANT, *Tour*, 4to., London, 1790, ii, 168. ACOUSTICS; EAR OF DIONYSIUS; WHISPERING GALLERY.

2. 4. 14. 19.

In the reading room at the British Museum in London, when few are present, a very great repetition is observable. Standing in the centre, the echoes seem to come from the crown of the dome; if on one side, the echoes come from the opposite side.

s. s.

ECKL, see EGGL (WILHELM).

ECLECTICISM (from Gr. ἐκ and λέγω). The tenets or opinions of a sect of Greek philosophers founded (DIOGENES

LAERTIUS, *Proem.*, 21) at Alexandria by Potamon. They professed not to follow any particular master, but to select from every source whatever opinions might appear good and solid; from this habit of selection, they called themselves *ἐκλεκτικοί*. The school of art established at Bologna by the Caracci professed the same principles, and assumed the same name.

In modern art the word signifies a science manifested in selecting the presumed perfections, whether theoretical or practical, of every style or manner; and in engrafting or commingling the characteristic features of two or more styles as occasion may require. Nothing narrows the mind and cramps the invention more than the blind admiration and pursuit of one style to the condemnation of every other; the danger, however, of eclecticism is that, numerous objects of beauty being selected, they are too often put together in an incongruous way: whence the French saying 'l'éclectisme est la plaie de l'art.'

A. A.

Some of the correspondence and remarks which appeared here and in France on this saying, adopted by Lassus as his motto in the competition for Lille cathedral, will be found in the *Journals* for the years 1856 and early part of 1857.

ECOLISMA, or CIVITAS ECOLISMENSIMUM. A Latin name for ANGOULÊME in France.

ECPHORA. This word, being the Gr. *ἐκφορά*, the act of carrying or springing forth, is used by VITRUVIUS, as the equivalent of the Lat. *projectura*, to signify projection, as in the base inclusive of its plinth, from the *face*, and not, as stated by some authors, from the *centre*, of the shaft of a column.

I. 2. 4.

In iii, 5, he directs the projection (*projecturamque quam Græci ἐκφοράν vocitant*) of the plinth of the base of a column to be the fourth part of the diameter of the column, "so that", as he says, "it shall be in length and in depth one and a half times the thickness of the column." Of course in this case he measures from the face of the column, and not from the centre line. And further on in the same chapter, speaking of the projection of the corona, he says it should be as much as the height from the *sophorus* (or frieze) to the top cymatium of the corona; and adds "et omnino omnes ecphoræ venustiores habent speciem quæ quantum altitudinis, tantundem habeant projecturæ"; in other words, the best amount of projection is that which equals the height, of each part. In this case also he does not measure from a centre line.

A. A.

ECTYPE. One of a series of words frequently found in classic writers, and used by them in two senses; first as to objects in pottery; and secondly as to carving on gems, or as to sculpture of various kinds. The word has been derived by some authors from *τύπος*, which they interpret (Lat.) *forma*, or a mold into which clay is pressed or beaten, to produce a figure which is afterwards burnt. There is no doubt that *τύπος* is derived from *τύπω*; but it is not so certain that these authors are correct when they say that *ἀντίτυπος* is the figure modelled, and *τύπος* the mold out of which another figure is produced. TYPE.

As to objects in pottery, the principal passage in which the word is used in relation to architecture is in PLINY, *H. N.*, xxxv, 21, who relates that Dibutades was "the first who added masks (ANTEFIXÆ) to the ends of the imbrices, which (interitiâ) in his first attempts he called *protype*; but he afterwards made them *ectype*": the meaning of these words as applied to molds, or pottery-ware made out of molds, will be considered s. v. TYPE.

As regards sculpture on gems, or on cippi, termini, etc., three words have been used, viz. *entype*, *ἐντυπος*, which all authorities agree to refer to objects recessed or cut in, as intaglio work; *ectype*, which some of the best authorities suppose to be high relief; and *protype* (which is most probably *prostyle*), *πρόστυπος*, which the same authorities suppose to be low relief, as cameo work.

It however seems probable that these two last meanings

ARCH. PUB. SOC.

ought to be reversed. PLINY, xxxvii, 10, says "these are the gems which may be engraved in ectype": and SENECA, *De Benefic.*, iv, speaks of a ring having "a figure in prominent ectype." Now from their size and their hardness it seems almost impossible to engrave gems in high relief, though they make excellent cameos in very flat relief; and might even make a bas-relief, which might be designated as a prominent cameo. But a passage from PLATO, *Symposium*, ed. Stalbaum, p. 81, seems to set the matter at rest. In this dialogue Aristophanes has broached the fanciful theory that every body has two souls within it joined together, and says "we must be careful not to offend the gods, or they will take away one soul from us; and we shall go about like the figures carved in ectype on the *στήλαι* (pedestals, termini, cippi), which are sawn in half through the nostrils, and look like split dice (*διππας*)."¹ It is clear that a head cut exactly in half as described could not be said to be in high relief: and therefore by ectype PLATO must have meant bas-relief. The reason why *prostyle* is considered to be alto-relievo will be given s. v. PROSTYLE. A. A.

ECUYER (. . . L'), see L'ECUYER (. . .).

EDAM (JACOB VAN) designed 1530 and superintended the erection of the tower of the great church at Hoorn; the whole edifice was destroyed by fire 3 August 1838. VELIUS, *Chronyken van Hoorn*. 24.

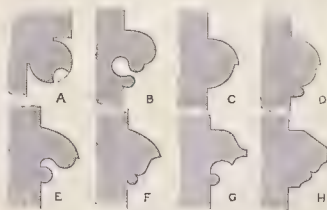
EDDYSTONE, see LIGHTHOUSE.

EDFOO, EDFOU, or EDFU. The modern name of APOLLINOPOLIS MAGNA in Egypt.

EDGE. The junction, sometimes called *arris* (It. *canto*; Fr. *arête*, *carne*), of any two sides of a body which make together a salient angle. In materials this edge is generally more or less naturally rounded or incomplete; and thus the trades which are occupied in building daily use the expression of 'bringing up the edge to an arris', i. e. to a sharply defined line (It. *canto vivo*; Fr. *vive arête*). The edge which divides the flutes in a column of the Doric order was worked to as fine an arris as the material would allow; in late Romanesque, and in the two first periods of the Pointed style, the large round moldings in shafts and arches were frequently finished with a sharp edge or KEEL. The term edge is otherwise restricted, in building, to any very narrow surface (It. *orlo*; Fr. *bord*, *tranche*), which may be the subject of mensuration; for the word is usually applied to that side which forms the narrowest face or surface of a body; e. g. to set a 'brick on edge' (Fr. *mettre de champ une brique*); the edge of a board, of a joist, etc.

EDGE BUTT HINGE, see BUTT HINGE.

EDGE MOLDING. The term appropriate to the round molding, having on its face a sharp projecting edge caused by one half of the section being formed by a smaller radius than the other; this profile, common in Second Pointed work, was



frequently used in stringcourses, having the larger curve placed uppermost. The usual type of this molding is shewn at c; the Norman profile, A, as at S. Mary's Guild,

Lincoln; the Early English form, B; D is Decorated work; E and F from S. Stephen, Westminster; and G and H are of the Perpendicular period.

EDGE SHAFT. A modern name for the pillar, in doorways and windows, which sustains an arch so united by the sides and back to the nearest wall or arch, that the shaft appears to support only the edge over it. "Edge shafts are so abundantly used in Norman buildings, that they may be said to be characteristic of that style; while, on the other hand, they are excluded from the Lombard and Pisan, and very sparingly used in the German Romanesque, but appear

pretty freely in the Byzantine and Romanesque of the south of France. In place of them, the next class is made use of, which I shall call nook-shafts": WILLIS, *Remarks*, 8vo., Cambridge, 1835, p. 35.

EDGING (Fr. *bord, bordé, bordure*). The name given to something applied, by way of ornament, on the edge of another thing, as a carved molding on the outside of an architrave or dressing. BRATTISHING.

EDGING. The operation of reducing the edges of rafters or ribs, whether on the upper or on the lower side, so that they may suit any required plane: this is also called RANGING. One particular kind of edging is BACKING, which only applies to work done on the outer edges of rafters or of ribs: and FIRRING is edging out joists, when sunk, to a level to receive new floor boards.

1. 2.

EDIFEX and EDILE, see *ÆDIFEX* and *ÆDILE*.

EDIFICE (Fr. *édifice*). According to the derivation of this word through the Lat. *œdificium*, from *œdes* a house, it might seem a proper term for a dwelling; but custom has given it a higher signification. It has been used as synonymous with 'building', 'erection', 'fabric', and 'structure'; but while an ordinary structure is called a 'building', the word 'edifice' is usually applied to a stately, large, or important, architectural fabric.

2. 4. 25.

EDINBURGH. The chief town of Edinburghshire or Mid-Lothian, and the metropolis of Scotland. Leith, about two miles distant, is the port, and may almost be considered a suburb, of Edinburgh. The city, about a mile and three-quarters across each way, may be divided into three parts: first, the old town, consisting of irregular houses, some being ten stories in height, built in a multitude of narrow 'wynds', 'closes', and 'courts', mostly leading at right angles from both sides of the High-street, and the streets called the Canongate, Cowgate, and Grassmarket. In the Cowgate are still remaining some houses dating about 1490 or 1500. Moray house dates cir. 1628. Secondly, the new town, erected according to plans forming regular streets and squares; the greater portion being built of white freestone from the quarries of Craigleith, Craycrook, Padhall, and Revelston. The first built portions, comprising Princes, George (115 ft. wide), and Queen, streets, and the cross streets connecting them, were designed 1766-8 by J. Craig. Moray-place, Royal Circus, and the neighbourhood forming the lower new town, were laid out partly in 1800 by R. Reid and others, and partly by J. Gillespie Graham in 1815, and by W. H. Playfair. Another new town, to connect Edinburgh and Leith, was designed by W. H. Playfair; but only a very small portion of the plan has been executed, consisting chiefly of three long ranges of houses, called the Royal and Regent terraces, and Carlton-place, on the eastern slopes of the Calton-hill. Thirdly, the south town, which is without any of the pretensions of the other part, but has many good houses and old fashioned squares: Brown's and George squares were erected by James Brown, a builder, in 1763-6. A quarter of a mile further south are the new suburbs of Newington and Grange, and to the west of these Whitehouse, Greenhill, Morning-side, and Merchiston, all separated from the city by the public parks, called Bruntsfield links, and the Meadows; the latter, of sixty acres, are not yet laid out ornamentally. Cockburn-street, a new street, named after the late Lord Cockburn, is now in progress from the general railway station at Waverley bridge to the High-street, for which a company obtained an Act of Parliament in 1855. The street is about 800 ft. long and 50 ft. wide, with a gradient of 1 in 14. The houses on each side, which are to be erected by the company, from designs by their architects, Messrs. Peddie and Kinnear, are in the old Scottish baronial style; the lower story is generally devoted to shops.

The city was first supplied with spring water in 1681, by a lead pipe of 3 ins. bore, laid from Comiston, three and a half miles south-west of the city. In 1821 the present water supply

was commenced by James Jardine, C.E., from Crawley Spring, seven miles south. Gas was first applied in 1818; the circular stalk, erected 1845-6, at a cost of £5,000, is described in the CIVIL ENGINEER, etc., *Journal*, xiii, 398; it is 341 ft. 6 ins. high from the foundations, and 26 ft. diam. outside.

The peculiar position of the city necessitated the construction of several bridges: the North bridge, 21 October 1763, continued 1765-9, by W. Mylne, cost £10,000; three vaults of the south abutment fell in August 1769, and were rebuilt 1772; it consists of three arches each 72 ft. span, 68 ft. high, and 40 ft. wide: the two small arches, one on each side, are each 20 ft. span, which together with a number of masked arches, make a total length of 1270 ft. inclusive of the abutments: the South bridge, 1 Aug. 1785, opened March 1788, cost £15,000; it has twenty-two arches, but only one is visible, that over the Cowgate, 30 ft. span and 31 ft. high: Regent's bridge, 1815-19, by A. Elliot, having one arch over Calton-street, 48 ft. wide, 55 ft. high, and 80 ft. deep: George IV bridge and Western approach, completed 15 Aug. 1827, by T. Hamilton, has three groined arches across the Cowgate, with two long abutments: and the Dean bridge (crossing the great 'dean' or ravine through which the rivulet called the Water of Leith passes, on the north-west side of the city), 1833, by T. Telford, C.E., has four stone arches 96 ft. span, and is 447 ft. long; the road, 106 ft. above the stream, is 39 ft. wide between the parapets. The Earthen Mound, 1783, is 800 ft. long, 92 ft. high on the south, 58 ft. on the north, and 250 ft. wide at the top.

The public memorials consist of an equestrian statue of lead of king Charles II, 1685, the artist unknown; Frederick duke of York, 1836, by Westmacott; William Pitt, of bronze, 1833, by Chantrey; George IV, of bronze, 1831, by Chantrey; Watt, of Caen stone, 12 May 1854, by Peter Slater; Melville, of bronze, 1855, 12 ft. high, by John Steell, with a pedestal 15 ft. high; with the bronze equestrian statue of the earl of Hopetoun, 1834, by Campbell; and of that of the duke of Wellington, 1852, by John Steell: there are many others in the various public buildings. The monuments comprise that to Nelson, a circular tower 108 ft. high, 31 Oct. 1807-15, by Robert Burn: the National (erected to commemorate those who fell at Waterloo and in the other engagements during the war with France), commenced 27 August 1822, by W. H. Playfair, from the designs of C. R. Cockerell of London; it was intended to have been a reproduction of the Parthenon at Athens; twelve columns only at the west end were erected, which are said to have cost £1,000 each; the total cost about £15,000: Dugald Stewart, somewhat resembling the choragic monument of Lysicrates at Athens, 1830-1, by W. H. Playfair: Burns, a study from the same example and the temple of the Sibyls at Tivoli, by T. Hamilton: Walter Scott, an elaborate Gothic cross 200 ft. 6 ins. high, Aug. 1840—15 Aug. 1844, by G. M. Kemp, who died before it was completed; the statue by J. Steell: Professor Playfair, of four Grecian-Doric columns on each side, by W. H. Playfair: Melville, after Trajan's column at Rome, but without the sculpture, 1821-2, by W. Burn, is 136 ft. high including a pedestal 18 ft. high, and completed with a statue 14 ft. high: and that to the Political Martyrs of 1793, a plain obelisk 90 ft. high.

The new royal botanic gardens at Inverleith, of twelve acres, were opened 1824, and have been since greatly extended.

The city churches are fourteen in number: twenty-three are in connexion with the Established Church; among these, S. Giles, formerly the cathedral, dates before 1359; it was made collegiate 1466; was largely altered and repaired, 1829, by W. Burn; and now contains three places of worship, the High, and the Tolbooth, churches, and the hall prepared for the General Assembly, now used as the 'old church'. It is 206 ft. long, 110 ft. wide at the west end, and 76 ft. at the east. The spire, 161 ft. high, supported on the apex of four arches forming a crown, was repaired 1648. The contract dated 1380, to vault over a part, and the agreement, 1387, for building five

chapels on the south side of the nave (both portions destroyed in 1829), are given in BANNATYNE CLUB, *The Chartulary of S. Giles*, 8vo., Edinb., 1859; in MAITLAND, *History*, p. 270; and in WILSON, *Prehistoric Annals*, etc., p. 631. Trinity college church, 1462, pulled down 1848, had the stones carefully numbered for re-erection: the old Grey Friars (Gothic), completed in 1612, burnt 1845, was restored 1846-57 by D. Cousin; the new Grey Friars church was added to the west end 1719-21; the churchyard is noticeable from the numerous monuments to remarkable persons: Christ's, or Tron (Italian), 1637-47, was rebuilt 1786, all but the tower and north front; the spire, 160 ft. high, was rebuilt 1828, by R. and R. Dickson; S. Cuthbert or West kirk (Italian), 1770, the spire 1789, is erected on the site of a church dating 690, and which is said to have been the earliest church erected in England or Scotland; S. Andrew, 1781; the spire 1789, 168 ft. high, has a tetrastyle Roman-Corinthian portico, and is of an oval form: S. George, 1811-14, by R. Reid, cost £33,000; the front, 112 ft. long, has a tetrastyle Ionic portico 35 ft. high; a dome 48 ft. in diameter rises to 160 ft. from the ground: S. Mary, Bellevue-crescent, 15 August 1823-4, by Thos. Brown, holds 1,600 persons, cost £13,000; S. Stephen (Doric), 1826-8, by W. H. Playfair, cost £25,000; the tower is 126 ft. 6 ins. high: S. John, 15 April 1839—19 Nov. 1840, was designed by G. Smith.

There are twenty-five Free churches; fifteen United Presbyterian; eight Episcopalian; and about twenty of other denominations. Among these may be mentioned the Roman Catholic chapel, Broughton-street (Perpendicular), 1813-4, by J. G. Graham, cost £8,000; the internal dimensions are 110 ft. long by 57 ft. wide: S. Thomas' chapel (Norman), 1843, by D. Cousin; S. Paul's Episcopal chapel (Perpendicular), 1816-8, by A. Elliot, cost £12,000, a nave and aisles only; the internal dimensions are 105 ft. long, 63 ft. wide, and 46 ft. high; the nave is 26 ft. wide, and has a plaster vault after the form of King's College chapel, Cambridge: S. John's Episcopal chapel (Perpendicular), 1816-8, by W. Burn, cost £15,000; it is 109 ft. long and 66 ft. wide: Trinity Episcopal chapel, Dean bridge (Perpendicular), 1839, by J. Henderson; Baptist chapel, Dublin-street (Geometric), 1857, by Messrs. Peddie and Kinneir: an Independent or Congregational church, George IV bridge (Byzantine), 1859-60, by Messrs. Hay of Liverpool: Free S. Bernard's church (Gothic), 1855, by — Milne of S. Andrews: Free S. Mary's church (Perpendicular), 1859-60, by J. A. Rothead of Glasgow: Free Buccleuch church (Geometric), 1855, by Messrs. Hay of Liverpool, the spire incomplete: and Greenside church (Early English), 1838, by J. G. Graham; the tower added 1853.

Besides the old churchyards and burying grounds within the city, six cemeteries have recently (since 1845) been artistically laid out at some distance from the town, as at Warriston (north), Grange (south), Dalry (west), near Newington (south-east), Dean (north-west), and Bonnington near Leith (north-east); all of which, with the exception of that of Grange, were laid out by D. Cousin.

The castle was greatly ruined at the siege of 1573. The series of buildings at the south-east angle of the upper quadrangle constituted what remained of the palace previous to 1573: the officers' barracks might have been the palace of David I; on the south side are traces of a hall, 80 ft. long, 33 ft. wide, and 27 ft. high, with a fine timberwork roof, forming now the garrison hospital; a Norman chapel is said to be the oldest chapel in Scotland; the crown room dates 1615, the period at which the castle was largely re-edified. The military barracks date 1796; the cavalry barracks at Piershill are of the same time. The parliament house, 1632-40, cost £11,630; between 1808-40 a very large mass of building has been erected about it for the courts of law, etc., presenting an extreme length and breadth of 500 ft. and 240 ft.; with an arcaded colonnaded façade to Parliament close and High-street. The large hall, used by the Scottish parliament, and now as an ante-room to

the courts of law, is 122 ft. long and 49 ft. wide, having a lofty timber roof of Jacobean character, 1632-40. Below the hall, and in various adjoining apartments, is contained the Advocates' library, consisting of about 150,000 printed books and 1,700 MSS. A long building to the west contains the library of the Society of Writers to the Signet, above 50,000 volumes, in two colonnaded rooms, one above the other; the lower room, 1815, by W. Stark of Glasgow; the upper by R. Reid; in the centre of the latter is a dome or cupola painted by Stothard. The large new room for the Advocates, behind that of the Writers to the Signet, is by W. H. Playfair. The royal exchange (Italian), 1753-61, by J. Fergus, has a court of about 90 ft. square, cost £31,000; the body, forming the north side of the court and occupied as the city chambers, ten stories high behind, is 111 ft. long and 51 ft. wide. The register house (Italian), commenced 27 June 1774, by R. Adam, forms a square of 200 ft., and is surmounted by a dome, 50 ft. in diameter and 80 ft. high, lit by an eye 15 ft. in diameter; an additional building for the public records is now being erected behind the register house, in the Italian style, by R. Mathieson.

The university was founded 1581; its new buildings, first stone 16 Nov. 1789, by R. and J. Adam, were estimated to cost £63,000; the works were suspended in 1804, after a cost of £50,000 in the execution of one third of the plan, until 1815, when the building was altered and completed by W. H. Playfair, at a cost of £126,000. The court is 356 ft. long by 255 ft. wide; and the library, of about 100,000 volumes, 198 ft. long by 50 ft. wide, with an arched roof from 50 to 58 ft. high. The shafts of the six columns in front, of the Doric order, are each 23 ft. high and 3 ft. in diameter in one stone, from the Craigleith quarries. The observatory, 1818, by W. H. Playfair, is in the form of a Greek cross presenting four hexastyle Roman Doric porticoes, with a small dome at the intersection. The royal institution on the Mound, containing the offices of the trustees for the promotion of manufactures and fisheries; a school of art under their patronage; galleries for pictures and sculptures; and apartments for the meetings and museums of the Royal Society of Edinburgh and of the Royal Society of Scottish Antiquaries, was commenced in 1825 by W. H. Playfair; it is erected on piling and framing, which cost £1,800; it forms a parallelogram 180 ft. long and 110 ft. wide; at each of the north and south ends is an octastyle portico of fluted Grecian Doric columns supporting a pediment; and on each of the east and west sides is a range of fourteen columns; at each end of these side colonnades are two columns with a pediment; the stone is from Collallo in Fifeshire. Southward from this building, also on the Mound, is the national gallery, 30 August 1850-54, by the same architect, cost £50,000. Each side contains five octagonal saloons; the central one 43 ft. diameter and 30 ft. high; two others 36 ft. diameter and 24 ft. high; two of an oblong form 36 ft. by 26 ft.; and two 22 ft. in diameter; these last being 22 ft. high; all being lit by cupolas in the centres of plain coved ceilings; it is also a parallelogramoid 270 ft. long by 80 ft. wide, having two hexastyle porticoes of plain Ionic columns supporting pediments on the east and west sides; and by two tetrastyle Ionic porticoes, connected by colonnades, at each of the north and south ends (six porticoes in all). It cost £50,000; the stone was obtained from Binnie in Linlithgowshire; the foundations, of concrete, cost £5,000: *BUILDER Journal*, xv, 323. The assembly hall, for the use of the General Assembly of the Church of Scotland (Decorated Gothic), 1844, by J. G. Graham, after a design by A. W. Pugin, is 110 ft. long and 75 ft. wide, with a projecting tower at the east end; the spire is 241 ft. high. The assembly rooms (Roman Doric), 1786; the music hall, added 1818, by W. Burn, cost £10,000, including the organ; it is 108 ft. long and 91 ft. wide, and seats 1,800 persons; the assembly room is 92 ft. long, 42 ft. wide, and 40 ft. high: a plan is given in BLACK, *Guide*, etc. The Adelphi theatre, 1853, is by D. Bryce. The music class room (Italian), 1859, by D. Cousin, cost £6,000.

Among the other public buildings are the county hall (Grecian Ionic), 1817, by A. Elliot: post office (Italian) is now (1859) in course of erection by R. Mathieson: corn market, 28 June 1848-9, by D. Cousin, cost £17,000; the front is 100 ft. long and 60 ft. high, the large hall 152 ft. long and 92 ft. wide; *ILLUSTRATED LONDON NEWS*, xv, 373: the bridewell, Calton-hill, 30 November 1791-6, by R. Adam, cost £12,000: debtors' prison, by T. Brown, jun., 1845: new prisons (castellated Gothic), by A. Elliot, 1815-7: premises (Italian Corinthian), 1768-81, by Sir W. Chambers for Sir L. Dundas, was occupied by the royal bank 1825; new telling room and other additions are now in progress by Messrs. Peddie and Kinnear; *BUILDER JOURNAL*, xvii, 315: national bank, 1825: bank of Scotland (Italian Corinthian) by R. Crichton, 1806; foundations are 100 ft. below the street: the three following are by D. Bryce, British linen company's bank (Italian), 1850; western bank of Scotland (Italian), 1848-9; and Edinburgh and Glasgow bank (Italian), 1841-2, frontage extended 1848-9: life association of Scotland (after the palazzo Pesaro, Venice), 1855-9, by D. Rhind, is of Binny stone; *BUILDER JOURNAL*, xvii, 13, and *BUILDING NEWS JOURNAL*, v, 143: commercial bank (Italian Corinthian), 1846, by D. Rhind: the sculpture in the pediment, modelled by James Wyatt and executed by A. H. Ritchie, is given in the *ILLUSTRATED LONDON NEWS*, ix, 37: and Freemasons' hall, 1858, by D. Bryce, the large room is 75 ft. long, 36 ft. wide, and 33 ft. high.

Among the public institutions are Heriot's hospital (Jacobean), said to have been designed by Inigo Jones, but for this there is no evidence whatever, and the whole style is at variance with anything known to have been designed by him (*RITCHIE, Report as to who was the Architect*, etc., 8vo., Edinb., 1855; and STEVEN, *Memoir of G. Heriot*, 16mo., Edinb., 1845, new edit. by BEDFORD, 8vo., 1859); William Wallace was master mason, and had six pounds Scots or ten shillings sterling per week, and one hundred pounds Scots of yearly salary; and Andrew Davidson was overseer, and had three pounds Scots a week; Wallace was succeeded by William Aytoune in 1631-2; the treasurer's accounts are very minute; the edifice was commenced 1 July 1628, continued to 1639, recommenced 1642, and completed 1650, at a total cost of £30,000; it forms a quadrangle about 163 ft. square, with an interior court 92 ft. square; the chapel, 60 ft. long, 22 ft. wide, and 40 ft. high, was refitted about 1840 by J. G. Graham; *GOLDICUTT, Heriot's Hospital*, 4to., London, 1826: royal infirmary (Italian), August 1738, by William Adam, containing 400 beds, consists of a body and two wings, five stories high, 260 ft. long altogether; in the centre is a staircase up which sedan chairs could be carried; wing added for surgical hospital, 1854, by D. Bryce: Stewart's hospital (Jacobean), 1848-55, by D. Rhind, cost £30,000: Donaldson's hospital (Tudor), 1842-8, by W. H. Playfair, for 200 children; the building is 269 ft. long and 275 ft. wide, and the quadrangle 176 ft. long and 164 ft. wide; the boundary and terrace walls, 1849, cost about £12,000; the total cost about £130,000; *BUILDING CHRONICLE*, i, 144, 158: George Watson's hospital, 1738-41, by Wm. Adam, cost about £5,000; it was much altered, 1859, by J. Lessells, cost £10,000: John Watson's hospital, 1835, by W. Burn, 250 ft. long by 60 ft. wide, with a projecting portico of six fluted Doric columns on its east front: the merchant maiden hospital (Grecian Ionic), 1814-6, by W. Burn, cost £12,000: the new orphan hospital (Grecian), 1833-6, by T. Hamilton: Gillespie's hospital (Gothic), 1801, by R. Burn: asylum for the blind, 1806: lunatic asylum, by R. Reid, 1810, enlarged 1839 by W. Burn, and 1856 by D. Bryce: institution for the deaf and dumb, 1825: physicians' hall (Italian), 1845, by T. Hamilton; *ILLUSTRATED LONDON NEWS*, vii, 232: royal college of surgeons and museum, 27 March 1830, by W. H. Playfair, with a portico of six fluted Grecian Ionic columns on a basement, cost £10,000: Queen-street hall (Italian), by J. D. Peddie, opened 8 May 1848, for 1200 persons: high school (Grecian Doric), commenced 28

July 1825, opened 23 June 1829, by T. Hamilton, cost about £30,000: new, or college of the Free Church (Tudor Gothic), begun 3 June 1846-50, by W. H. Playfair, cost £40,000 for site and building: new normal school, opened 19 May 1845, for 450 children, cost £10,000: Cowgate Part school, 1853, by A. Black: the Edinburgh academy, 1825, by W. Burn: and the seven Heriot foundation schools, by A. Black, commenced 17 April 1837; another 6 September 1838; another in 1845; with others later.

The railways comprise the Edinburgh, Leith and Granton, 1836; the Caledonian, the station (incomplete) 9 April 1847-8, by W. Tite; the Edinburgh and Glasgow, opened 18 Feb. 1842; the North British, opened 1846; and the Edinburgh and Dalkeith, 1826. The Union canal to Falkirk, formed 1817-22, cost about £500,000.

In the neighbourhood, near Arthur's Seat, is a small Gothic ruin called St. Anthony's chapel, of which the date is unknown; it appears to have been originally 43 ft. by 18 ft., with a groined roof about 18 ft. high; *MAITLAND*.

Holyrood, an abbey founded in 1128, was destroyed by fire in 1335; the north-west portion and three towers were rebuilt by James V, 1528; in 1588-90 an amount of £20,000 was spent in repairs, etc., under the direction of William Schaw, master of the works to the king. In 1674-79 the church was repaired, a throne and twelve stalls put up, and the palace nearly rebuilt as an almost direct copy of Chantilly the abode of the Condés in France, by Sir W. Bruce, master of the works; the chapel is in ruins, the roof having fallen in 1768. In 1822 the palace was improved internally, and since that time the entire building has been thoroughly repaired. It has a central court 94 ft. square; with a gallery 150 ft. long, 27 ft. 6 ins. wide, and 18 ft. high, in which the nobility of Scotland meet to elect their representatives; the breakfast room, Mary queen of Scots' room, and a sundial called queen Mary's, but of much later date, are given in *ILLUSTRATED LONDON NEWS*, xvii, 292; and views, 313; plans, etc., in ADAM, *Vitruvius Scoticus: History of the Palace*, 12mo., 1821; WILSON and ANDERSON, *History*, 1852. An elaborately carved fountain of Gothic work, copied from that in Linlithgow palace, has been put up in front of the palace, 1859, by R. Mathieson.

BILLINGS, *Baronial, etc., Antiquities*, fol., Edin., 1840-52; BLACK, *Guide*, 8vo., Edinb., 1858; CHAMBERS, *Gazetteer of Scotland*, 8vo., Edin., 1832, who graphically describes the old houses; BROWNE, EWBANK, and LAZARS, *Picturesque Views*, fol., Edinb., 1825; LAWSON, HALL, and HARDING, *Scotland Delineated*, fol., Lond., 1847-50; BEATTIE, *Scotland Illustrated*, 4to., London, 1838; MAITLAND, *History*, fol., Edinb., 1753; MYLNE, *Descr. of Sir John Robinson's House*, 8vo., 1840; STEUART and COCKBURN, *Plan for the New Prison and Bridewell*, 4to., Edinb., 1782; STORER, *Views*, 8vo., 1820; THE BUILDING CHRONICLE, 4to., Edinb., 1855, in progress; ARCHAEOLOGICAL ASSOCIATION *Journal*, xiii; FORSYTH, *Beauties*, 5 vols., 8vo., Edinb., 1805-8; STARK, *Picture*, 12mo., Edinb., 1806; and especially ANDERSON, *History*, 8vo., Edinb., 1856, who, p. 599-606, gives a table of dates of streets, buildings, etc.; no work, however, treats on Edinburgh architecturally. Maps of the Society for the Diffusion of Useful Knowledge, Nos. 176 and 177.

EDNOTH OF WORCESTER, see WORCESTER (EDNOTH OF).

EDUCATION (COURSE OF ARCHITECTURAL). The object, at present, of all public establishments, called educational, is to instruct rather than to educate. Education means the bringing out, perfecting, cultivating, etc., the functions possessed by the student; instruction shows how to use certain faculties for certain ends; and as a rule it may be said that no one can educate except by instructing. In some cases the education is the accidental, or rather the unsought, end in instruction; while in other cases the instruction is the accidental means to education, the end; as for the most part in teaching the dead languages. Whether the pupil obtain for himself, or be sup-

plied with the elements of knowledge, he is simply instructed. The highest branch of this instruction consists in imparting a knowledge of the most recent developments of skill. The laws that govern matter and inventions of other minds, must be learnt before the pupil is competent to create. Education is the master to whom instruction may be a servant; when the facts are known, it is time to induce an attempt to group and arrange them. INSTRUCTION.

Whatever may be the preparation of the pupil with regard to the theory of the artistic and constructive attainments of the architect, the practical application of this knowledge is education (when properly managed) to be acquired in the routine of patient attendance upon a communicative master, whose confidence is the only means of giving a pupil the knowledge most important to future success, the manner of conducting business. Every architect who has had a master of this character, or who has himself taught pupils, must be aware that the system of apprenticeship for seven years (during which the highest amount of school learning may be acquired, especially in those branches the pupil himself may begin to see will be necessary to him, as chemistry, which with some similar studies may be rendered relaxations at school), as regards making a person fit to become at its termination the head of an office, is preferable to the arrangement which has obtained of late years, viz. of allowing a youth to remain at school or at college until he becomes to a certain extent intractable, and of then sending him to a builder for a year or two, to an architect or a surveyor for three or four years more, and then to the continent perhaps for a year, finally to become an 'improver' in as many offices as will receive him. In the one case the pupil may acquire a predilection for the manner of the master, in the other he may become sceptical as to the worth of the pursuit of aught but the fashion of the day. Four or five years from 16 or 17 to 21 with a communicative master, and then two or three more for variety of practice with other employers, are considered by some as better than either of the routines above described. With regard to 'working at the bench' it may be observed that the practice is good for a youth when the teacher has not been conscientious enough to put the right kind of instruction before him: and with regard to 'going on the continent', which is almost the first aspiration at the end of pupilage, it must be the experience of all who have travelled, at so early an age, that the young architect, unless specially prepared, is ignorant of what to seek, and how to see it. It might be added that a continental tour no longer gives the *prestige* which it conferred at the beginning of this century; and that the custom of passing a few weeks annually in study abroad or in our own country, is more advantageous to the architect, young or old.

A great obstacle to the advancement of the education of the pupil, at the present time, exists perhaps in the facility with which the crudest, even the absurdest and falsest, notions obtain the publicity afforded by the printer, and accumulate faster than the master can refute them, even to the most intelligent pupil: and this is the more to be lamented, as the almost unlimited range of knowledge demanded of the architect, is necessarily superficial; for he may in a single consultation be expected to evince amongst other qualifications, to one and the same client, the imagination of a poet; the skill of a painter and a sculptor; a knowledge of the higher mathematics and of ancient and modern languages; of great part of law, physical science, ecclesiology, and medicine; of universal history and geography; the practice of decoration and furniture; an acquaintance with any process connected however remotely with building; and general information, extending from court etiquette and aristocratic habits to peculiarities of pigs and the price of a tallow candle.

EDWARDIAN STYLE. A term used by some writers to designate the style of Pointed architecture prevalent during the reigns of Edward I, II, and III; but it is too inexact to

ARCH. PUB. SOC.

be of much value, as architectural style varied greatly during the long period comprised within the three reigns. s. s.

EDWARDS (FRANCIS), F.R.I.B.A., born in Southwark 3 September 1784, was apprenticed to a cabinetmaker in Moorfields, under whom he not only thoroughly acquired a knowledge of that business, but showed much talent for drawing and taste for architecture; he entered accordingly July 1806 the office of Soane; obtained from the Royal Academy 1808 the silver medal for measured drawings of the gallery of the British Institution in Pall Mall, and 1811 the gold medal for a design for a theatre. Leaving Soane's office in 1810, he assisted his former fellow-clerk, H. H. Seward (then in partnership with G. Byfield) for four days in the week until March 1823: at which period his own practice required his whole time, but the connection had been so amicable that Seward, retiring (immediately afterwards) from business, transferred many clients to him. Arbitrations; valuations in respect of public works; dilapidations; many dwelling-houses and villas in and around the metropolis; and smaller works therein, occupied a great portion of his time. His principal constructions were; the whole of the building and engineering operations of the Imperial Gaslight Company from its incorporation in 1823, except during the last few years of his life, when he was employed as consulting architect, retaining the superintendence of all works in connexion with its offices (John-street, Bedford-row, 1856), and dwelling-houses: the church of S. John, Critchill-place, Hoxton New-road, 1825-9, at a cost of £13,000, accommodating 2,000 persons: the seat of Thomas Broadwood, esq., Holmbush, Sussex, 1829 (*BUILDER Journal*, 1859, xvii, 708); additions to Wotton house near Dorking, 1830-53, for the Evelyn family: many houses, 1832-57, on the large estate of W. J. Evelyn, esq., Deptford: several works, before 1836, at the "Cannon" brewery, Knightsbridge (since pulled down), for Thomas Goding, esq., and the "Lion" brewery, Golden-square, for Messrs. Goding and Broadwood: the "Lion" brewery, Belvedere-road, Lambeth, 1836, for Messrs. Goding and Co., for whom he built many public houses, besides additions and alterations to the brewhouse: the residence No. 12 St. George's-place, Hyde Park Corner, 1837, for Thomas Goding, esq.: the union house, Romford, 1839, and subsequent additions: additions to Mount Clare, Roehampton, 1840, for admiral Sir Charles Ogle: additions and alterations to Messrs. Burnett's distillery, etc., Vauxhall, 1841 to 1857: and the new workshops, Horseferry-road, Westminster, 1856, for Messrs. Broadwood. He died 15 August 1857. F. E.

EDWARDS (JOHN) "Clerk of the Works of the Lord the King (Edward III) at the Castle of Leds" in Kent, had paid to him £20 on the 9th May 1370, and £100 on the 25th Oct. for the works there. DEVON, *Issue Roll*, 4to., London, 1835, 99, 327.

EDWARDS (WILLIAM), born 1719, was the son of a farmer in the parish of Eglwysilan in Glamorganshire. Engaged at fifteen in repairing the dry-stone fences of the farms in the neighbourhood, and later in building a workshop, a mill, and several houses, forges, and smelting houses, he aspired in 1746 to erect the new bridge over the river Taff at Llantrisant in the above county: this was of three arches, and was carried away by a flood two and a half years after; being bound to maintain it for seven years, it was re-erected by him of one arch 140 ft. span, 35 ft. high (being the segment of a circle whose diameter is 175 ft.; the roadway was 11 ft. 6 ins. wide); before the work was finished, however, the weight of the masonry on the haunches, pressing up the key-stone, forced it out; this was in 1751. He reconstructed the bridge by 1755, piercing the haunches with three circular openings; the diameter of the lowest being 9 ft., the second 6 ft., and the third or uppermost 3 ft.; this bridge is now standing. The fame of this work introducing Edwards to public notice, he erected others in the following order: the Usk bridge, over the river Usk in Monmouthshire; a bridge of three arches over the river Tawy

in Glamorganshire; Pont ar Tawy, in the same county, about ten miles above Swansea, of one arch 80 ft. span, with one perforation in each haunch; Bettws bridge in Carmarthenshire, of one arch 45 ft. span; Llandovery bridge in the same county, of one arch 84 ft. span, with one perforation in the haunch; Wychbree bridge, over the river Tawy, two miles above Morriston, of one arch 95 ft. span, 20 ft. high, with two cylinders in the haunch; Aberavon bridge in Glamorganshire, of one arch 70 ft. span, 15 ft. high, without perforations; and Glasbury bridge, over the river Wye, near Hay in Brecknockshire, of five arches, formed by small segments of large circles on high piers. The roadways of his first works being found to be too steep, by a cautious gradation he attempted to correct the fault, and by experience succeeded; where the abutments are secure from the danger of giving way, he used arches of much larger radius and of far less rise than general opinion had hitherto required. He united with his trade that of a farmer; and in 1750 was ordained by the body of Independents and chosen minister of the congregation in his native parish, where he officiated for forty years. He superintended the erection of the meeting house of the Rev. Lewis Rees, near Morriston, and dying in 1789, in the seventieth year of his age, he was buried in the churchyard of his native parish. His three sons then living, Thomas, David, and Edward, were brought up to the same business of masonry.

A plan and elevation of Pont y Pridd (the bridge of the Easthouse) or the New bridge at Llantrisant, are given in the *BUILDER Journal*, iii, 426-7, explaining, in addition to the dimensions above stated, that the depth of the keystone is $\frac{1}{4}$ of the span = 2 ft. 6 ins.; and CRESY, *Encyc.*, 426, says the spaces between the holes in the haunches were left hollow and filled up with charcoal. SNELL, *Stability of Arches*, 8vo., London, 1846.

His son DAVID proved very skilful in bridge building. Among many other such structures, he built in Carmarthenshire, Llandilo bridge, over the river Tawy, six miles above Carmarthen, of three very light, elegant, and large arches; Edwinstford bridge over the river Cothy; Pontloyrig over the river Taw; Bedwas bridge over the river Remny, between the counties of Glamorgan and Monmouth; and lastly Newport bridge, over the river Usk in Monmouthshire, completed in 1801; an arduous work when the hazards attending Welsh mountain floods and the furious Severn tides are considered. It consists of five arches on high piers; the central arch is 70 ft. span and 22 ft. 6 ins. high from its chord-line; the other arches 62 ft. span and 22 ft. high; the piers 14 ft. wide at the springing of the arch; and the height from low-water mark to the top of the parapet is 57 ft. He was living in Glamorganshire in October 1803 as a farmer. His son

WILLIAM was educated as a mason, and at that time superintended many of the locks and bridges of the Kennet and Avon navigation from London to Bristol, and probably rebuilt Caerleon bridge in Monmouthshire. MALKIN, *The Scenery, etc., of South Wales*, 4to., London, 1804, 83-94, to whose account no one has added any fresh information.

EEDGAH, see EADGHA.

EFFECT. The term used to express the general impression or result produced upon the mind of the spectator by a work of art; and therefore the object, attained with more or less success, for which the artist labours: for the various principles upon which this result depends, reference may be made to the articles, BREADTH; CHIAR-OSCURO; COLOUR; CONTRAST; PROPORTION, etc. H. B. G.

The delineations of their ideas which architects present to the public are often inexpressive of the result to be anticipated; and as it is almost impossible for an architect to foretell exactly the effect from an outlined or even a shaded geometrical drawing, without a long habit of comparison between work as drawn and as executed, the best architects have usually prepared small models of the whole, and patterns to the full size of the parts;

as by Buonarroti for the cornice of the palazzo Farnese, and by Wren for St. Paul's. It is not unusual to read of breadth of effect when an effect of breadth is meant; of general effect as inclusive of the effects of form, chiar'oscuro, and colour; and even of accidental effects, *i. e.* produced by nature. LOUDON, *Arch. Mag.*, 8vo., London, 1834-9, iii, 145, has translated the article upon this subject by QUATREMÈRE DE QUINCY, *Dict.*, who has written the following remarkable passage: "Les modernes,—dans presque tous les genres, pour faire de l'effet, ont voulu que tout fût effet; c'est le moyen le plus sûr de n'en point faire." 6.

PHILLIPS, *Principles of Effect and Colour*, 4to., London, 1838, 3rd ed.; BURNET, *Treatise on Painting*, in four parts, 4to., London, 1837; HARDING, *Principles, etc., of Art*, fol., London, 1845; PROUT, *Hints on Light and Shadow*, 4to., Lond., 1838.

EFFIGY, see PORTRAIT, SEPULCHRAL BRASS, etc., STATUE, and WORKMAN.

EFFLORESCENCE. The property by which certain salts containing water of crystallization part with it, and become opaque by exposure to the air: in some cases, salts which do not contain much water preserve their form; whilst others which contain a large quantity are not only rendered opaque, but lose their crystalline figure, and become powdery by efflorescence: such are sulphate, and carbonate, of soda. The efflorescence of some salts may be prevented by varnishing or oiling them. It has also been observed by FARADAY that the property of efflorescence appears in some cases to depend upon the superficial fracture of the crystal: thus he found that crystal of carbonate, phosphate, and sulphate, of soda having no parts of their surface broken, and being carefully preserved from external violence, remained perfect; but upon breaking or scratching their surface, efflorescence began at that part, and eventually extended all over the crystal. 14.

The surface of new walls, especially those built with bricks which have not been very much burnt or vitrified, are often found to become spotted with a white, silky, light, and dusty efflorescence, generally composed of the sulphates or the nitrates of lime, magnesia, and soda, and sometimes of muriate of soda, which are easily recognized by their fine crystalline character, and by their cool and disagreeable acidulated taste. This floury substance gathers on new walls very rapidly; but being soluble, it becomes either melted by the rains or blown off by the winds; yet periodically accumulates again. It is produced by a chemical affinity which subsists between the acids of the atmosphere and the acids and alkali contained in the bricks, as well as in the mortar or cement which is used in bedding and connecting them together. Most brick earths or clays contain, besides their constituent alumina and silica, about $5\frac{1}{2}$ per cent. of carbonate of lime, and about $3\frac{1}{2}$ per cent. of carbonate of magnesia (sometimes a larger quantity of calcareous matter or chalk is added, in order to improve the appearance of the bricks which are to be made from it); iron in the state of oxide, or combined with sulphur; and common salt: these various materials, when exposed to a red heat, act chemically on each other; the magnesia most probably will combine with the sulphuric acid, which it obtains partly from the iron pyrites mixed with the clay, and partly from the fuel, if coal is used. It is this sulphate of magnesia (common Epsom salts) which is occasionally found to cover the surface of newly built walls with an efflorescence like hoar frost. When mortars or cements are made with water from mineral springs which contain muriate of soda, or with sea water which contains that muriate to the extent of about $\frac{1}{10}$ of its whole quantity, they will exhibit for a long time such a saline efflorescence.

It has also been observed by SMITH, (*Report from Commissioners on the Fine Arts*, fol., London, 1843; reprinted in the *CIVIL ENGINEER Journal*, 1843, vi, 424; and partly reprinted in the *BUILDER Journal*, xiii, 334, 1855,) that salts, alkalies, or acids, according to the usual acceptation of such terms, do not necessarily form any part whatever of building materials;

and he notes the highly objectionable practice of procuring the excrement, frequently of many kinds, from a cow-shed for the purpose of mixing it with mortar for 'pargetting', and the equally hurtful watering-places chosen by workmen among the materials, or even in the unfinished edifice. He adds that, under ordinary circumstances, it is scarcely possible to get rid of the various saline or deliquescent substances that have once been admitted into the walls of a building: the fixed alkalies (potash and soda) may probably be considered imperishable; no length of time can injure them; they may effloresce, or more properly, they may crystallize on the surface of a wall, and totally or partially disappear again and again, as often as a change in temperature or of dryness or humidity takes place; these changes may be daily, or the salts may remain inactive during ages, and from some favourable cause, a crop of crystals may be produced as flourishingly as if the wall had been recently erected. The only way to abate the evil is to brush off the crystals, dry, whenever they appear in the most flourishing condition. If potash has been introduced into the walls, either from the precipitation of animal or vegetable substances,—however thick the wall may be, it will make its way to the surface, and then absorbing nitrogen—nitrate of potash (saltpetre) is produced. He further observes that an increase of temperature, or a humid atmosphere, will slowly dissolve the salts; if both these causes occur at the same time, liquefaction will be rapid, and the newly formed fluid will be absorbed into the wall as fast as the salts are dissolved. These changes will take place with every variation of atmosphere; a cool dry air, in a state of absolute rest or stagnation, is favourable to crystallization; a warm one, charged with aqueous vapour, will facilitate solution. It is extremely probable that several kinds of salts may be formed on the same wall, with their crystals intermixed so as to escape the discrimination of a casual observer, and that each will crystallize and liquefy at different times, according to the temperature and the quantity of moisture in the atmosphere; should this be the case, perhaps the wall may never appear perfectly free from efflorescence, so long as the various stimulants of air, moisture, light, heat, and other causes of attraction are in activity.

Reference should be made to the subjects of secondary and tertiary limestones, magnesian limestones, and the gypseous formation, as treated *s. v.* ATMOSPHERIC INFLUENCE; as well as to the articles CERAMICS, DAMP, and DELIQUESCENCE.

Among others, as to the method of obviating this unsightly appearance, the following opinions have appeared in the *BUILDER Journal*, 1845, iii, 437; 1857, xv, 396 and 516, from which some of the preceding paragraphs have also been extracted.

The efflorescence may be easily washed away; but allow it to crystallize, then heat it, and rub it over the surface of the bricks so as to fill their pores; this will prevent the bricks in some measure from attracting and absorbing moisture from the atmosphere.

Wash the wall with a solution of chloride of calcium (or muriate of lime) which will convert the sulphate of soda into sulphate of lime (an almost insoluble substance, which will remain in the wall), and into chloride of sodium or common salt, which latter should be removed from the surface by subsequent washing. In order to prevent further production of efflorescence, or susceptibility to absorb moisture, well clean the outside of the wall, brush it over with a solution of silicate of soda or potash, followed by a solution of chloride of calcium, applied also with a brush: the lime immediately combines with the silica, forming silicate of lime in the pores of the stone; whilst the chlorine combines with the soda, forming chloride of sodium or common salt which is removed at once by water.

Take 4 lbs. of commercial carbonate of soda (natron), 2½ lbs. of commercial carbonate of potash (pearl ash), and 2½ lbs. of finely sifted silver sand; mix well and put them into a crucible (an iron one is best if not Hessian) capable of containing three times the quantity, and fuse for two or three hours—pour out

upon a stone or iron slab and allow it to cool, then boil in about one gallon of water until a saturated solution is obtained. Let the salt be scraped off as much as possible, and wash the wall well with warm water—then brush the hot solution prepared as above on all parts of its surface; give the wall another coat in three days time, and at the end of a week or two the wall will be covered with an impervious glassy coating, which will attain the desired effect. If applied to damp walls, they cease to be so. It will also prevent the white rubbing off.

EFFNER (JOSEPH), see EFFNER (JOSEPH), and ZUCCALI (ENRICO).

EGAS (ANEQUIN DE), sometimes called ANEQUIN DE BRUSSELAS from his birthplace, was appointed about 1459 maestro-mayor of the cathedral at Toledo, where he then directed the construction by his aparejador or assistant J. F. de Liena of the façade called de los Leones to one of the transepts. He died 1494, and was succeeded by his son Henrique. 66.

EGAS (ANTON) of Toledo, had a reputation so considerable that the bishop and chapter of Salamanca asked the king to send him to choose the site and make the design for their proposed cathedral. The royal order, dated 23 November 1509 to this effect, was served upon the domestics of Egas, who was then at Torrijos, and he disobeyed it on the ground that he was occupied on the works of Toledo cathedral; his name, however, does not appear in the list of architects engaged there. But in deference to another, dated 27 January 1510, he met A. Rodriguez at Salamanca; and their joint design and report were presented 2 May 1510: a drawing on parchment, supposed to contain this design, was preserved at least so late as 1800; and the report (which notices their difference of opinion as to the proper size of the capilla-mayor, and their intention of visiting Toledo to obtain a third architect's decision) is printed, as well as another dated 8 September 1512, which contains the opinions of Egas and eight other architects upon the popular clamour against the projected work, which was ultimately commenced 12 May 1513 by Juan Gil de Hontanón. 66.

EGAS (HENRIQUE DE), generally called as he signed simply, el maestro HENRIQUE, sometimes written Anrique, was a son of Anequin de Egas de Bruselas, to whom he succeeded 1494 as maestro or arquitecto mayor of the cathedral at Toledo; gave his daughter Maria Gutierrez in marriage to his pupil Alonso Covarrubias; and was father of Henrique, also an architect, of Diego, a sculptor, and of Juan, a painter. His memory is chiefly preserved by the fact of his having been the first of the Spanish architects to exhibit that knowledge of Italian art which in all his works testifies a date corresponding to the foundation of the transition from the Pointed to the Renaissance style in Spain. As P. Gumiel was summoned in 1500 to Toledo to advise with Egas upon the alteration of the capilla-mayor at the cathedral, the latter seems to have commenced his career of real success under the patronage of Don Pedro Gonzalez de Mendoza, arzobispo de Toledo y cardinal de España, for whom he erected at Toledo, 1480-92, the fine foundling hospital called Sta. Cruz, with a magnificent façade, courtyard, staircase, and galleries, 'in which the children are cared for better than in the arrangements of most paternal homes'; and at Valladolid, 1504-15, the colegio-mayor de Sta. Cruz, not less sumptuous in its portals than in its ceilings to the church (300 ft. long, on the plan of a Greek cross) and in its court. He designed 1504, for the Catholic sovereigns, the great general hospital at Santiago in Galicia; and probably watched its execution, as in 1505 he pleaded this occupation as the excuse for declining to rebuild, for the archbishop prince Alonso, the octagonal cimborio or dome (which he with four other architects had previously surveyed) to the cathedral at Zaragoza. He visited Seville in 1512 with P. Lopez and J. de Alava to give his opinion upon the mode of reconstructing the cimborio (which had fallen in 1511) to the cathedral; in 1515 he made a joint survey with J. de Badajoz and Alava upon the reconstruction of it, directed by J. G. de

Hontanon; and at the same time he made a joint design with Alava for the capilla-real of that edifice, which was immediately ordered for execution, but was not completed. In 1519 Egas constructed the drum of the dome of the mozarabic cathedral at Toledo; in 1522 he was commissioned with J. de Rasinaz and V. de la Zarza to present a report, which is printed, upon the works by J. G. de Hontanon at the new cathedral of Salamanca; he returned to that city 1529 with F. de Vigarni for a second report; and singly, as overseer (*veedor*) of the work, in 1534. In 1528 he surveyed the new cathedral at Malaga; and 1529 he also inspected with Vigarni the works, by J. G. de Hontanon, to the cathedral at Segovia, upon which occasion they replied to Alava's criticisms, which had been adopted by Covarrubias. The last named architect succeeded Egas, who died in 1534. 66.

EGAS (HENRIQUE DE), a son of the preceding, contracted 1548, at the price of 1000 ducats, for the execution of the Ionic portal of the alcazar at Toledo, under the direction of his brother-in-law Covarrubias; but as he showed that he lost by the work, a further sum of 500 ducats was paid to him by royal warrant dated 20 February 1552. 66.

EGELL (AUGUSTIN), born 1731 or 1734, was, like his father Paul who died 10 January 1752, sculptor to the elector of Mannheim, in which city he built the Rheinthor: he removed 1778 to Munich, where he died 1787. 68. 113.

EGEOVES. A term used in the contract dated 1421 for building a bridge at Catterick in Yorkshire, in the passage "And also w^t v. co'sees of Egeoves lik And acordande to ye same Thiknes of Egeoves as Barnacastelle brigge is of." This term has been supposed to designate the parapet or breastwork, but the old parapet is not now in existence. It has also been supposed to mean the walling at each end of the bridge, running at obtuse angles from each 'landstathe', up stream, for preventing the river from forcing its way behind the landstathes. Such a wall exists on the north-west end of the bridge, with a projecting base on which there are *five courses* of ashlar, surmounted by a coping. It has also been supposed to mean that there should be five ribs, as usually found in bridges of the mediæval ages, presuming that the term was obtained from the French *ogive* applied to arches. ARCHEOLOGICAL INSTITUTE *Journal*, 8vo., London, 1850, vii, 57, 60, 292.

EGESTA, sometimes written ÆGESTA. The ancient name of the town now called SEGESTA in Sicily.

EGG AND ANCHOR, EGG AND DART, or EGG AND TONGUE (Fr. *oeve et dard*). The familiar name of the decoration which is usually given to the ovolo or quarter-round on the capitals and on the bedmolds of most examples of the Ionic order; on the Tuscan capitals of the Trajan and Antonine columns; on the Doric capital of the thermæ at Albano; and in another found at a short distance from Rome, and given in CANINA, *Arch. Ant. Rom.*, fol., Rome, 1840, pl. 67. An egg, sometimes called in former days an ALMOND, is the leading feature of this decoration, and is almost always enclosed by a sort of cup; the eggs are generally separated from one another, by an ornament having usually the form of a barbed arrow-head, and assuming the name of the anchor, the dart, and the tongue, which last is for many reasons the most suitable, especially when the tongue is treated as a leaf, a bud, or a flower; sometimes the egg appears to be laid upon a large leaf, which turns over and partly envelopes it. The egg itself has been treated as a subject for decoration; and about 1615 it seems that the edge of the cup was enlarged, and also ornamented: with regard to this cup, it may be observed that NEVE, *Dict.*, says that eggs and anchors are the same as echinus, which is sometimes used to signify the quarter-round, but more commonly that part of it which includes the ovum or egg; and this use of the term echinus for the cup is adopted by QUATREMÈRE DE QUINCY, *Dict.* 4. 6.

Although there is every probability that the plain ovolo took its name from the flat bowl called ECHINUS, there has been

great controversy as to the origin of the ornament, in which most of our best writers have taken part. It has been considered an adaptation of a collar or necklace, appropriate to the goddess Isis, and composed of the mundane egg and the tongue of the serpent of immortality. By others it has been supposed to be a representation of arrow-heads, alternating with stones or pieces of metal shaped like almonds, which the ancients discharged from slings, of which the fillet surrounding the egg is taken to be a copy. Generally, however, the modern commentators upon VITRUVIUS have considered, since the time of BARBARO (*Vitruvius*), fol., Venice, 1567, p. 114, that the cup and its envelope were copied from the fruit of the chesnut just bursting from its prickly shell or pericarp. CANINA, *Arch. Græca*, ii, 4, seems to be of opinion that the idea was first taken from the chesnut; but he proceeds to show that the more elaborate form (where a sort of double pericarp is shewn) is exactly that of the fruit of the Theban palm; and that the point of the leaves of that plant resembles the dart always found between the so called eggs; and that the reel or *fusajuolo* beneath, resembles the seeds, *δακτυλοι*, of the date palm strung on a thread. ECHINUS; OVOLO; QUARTER-ROUND; BEAD AND REEL. A. A.

It may probably have been a naturalistic form, that is to say, an ornamental carving or painting on the molding, which the Greeks thought made the form tell the best. G. A.

EGG JOINT HINGE, see PEW HINGE.

EGG SHAPE. The name commonly given to any oval plane, but correctly to a particular form of which one end is described from a larger radius than the other. For the oval to be pure in form, when composed of segments of circles, it is necessary that the upper and lower curves should be connected by a portion of a circle tangential to both. MATHER'S formulas, where the upper curve (having its radius = *a*) touches the lower one (having its radius = *b*), then $\frac{a^2 + b^2}{a \cdot b} =$ the

radius of the tangential circle; and where the upper curve does not touch or intersect the lower one (putting *c* = the distance of the centres apart), then $\frac{a^2 + c^2 - b^2}{2a \cdot c} =$ the radius

of the tangential circle; are given in the CIVIL ENGINEER *Journal*, 1854, xvii, 115. Methods for drawing this shape are considered in the BUILDER *Journal*, 1845, iii, 503, 573, 623. OVAL.

EGGL or ECKL (WILHELM), who was *baumeister* at Munich, died there 1588. 113.

EGINA, see ÆGINA.

EGINHARDUS, ÆNARDUS, AGENARDUS, AINARDUS, EINHARDUS, or HEINARDUS (MAGNUS or SAPIENS), both near the Odenwald in Western Germany, was a pupil of Alcuin, who introduced him to Charlemagne. Under this monarch Eginhard became (*præfectus*) court-superintendent of buildings, at least at Aix-la-Chapelle; and afterwards he was entrusted by Louis le Debonnaire with the education of the prince Lothaire. It is supposed that, as a reward, he was made lay-abbot of the monasteries of Fontenelle afterwards called S. Wandrille, 816-23, of S. Bavon and S. Pierre de Blandigny at Gand, of S. Servais at Maestricht, etc., according to the *GALLIA CHRISTIANA*, v, 176, 190, 629; vii, 286; xi, 93. About 827-30 he constructed at Seligenstadt, then called Mulinheim, a monastery; in which he probably took the vows; and of which he appeared as abbot in 837 at Aix-la-Chapelle, and at Mentz in 848. His writings are given in DUCHESNE, *Hist. Franc. Script.*, fol., Paris, 1636, ii, 91, 232, with a memoir, prefixed to the Life of Charlemagne; but this does not mention the interesting drawing for a monastery, which was made by Eginhard for Gorpertus, abbot of S. Gall in Switzerland (from 815), as supposed by MABILLON, *Annales Ordinis S. Benedicti*, fol., Paris, 1704, ii, 571, who gives a copy of the plan that may be considered as inferior to another published by KELLER, Zurich, 1845, at four-fifths of the original

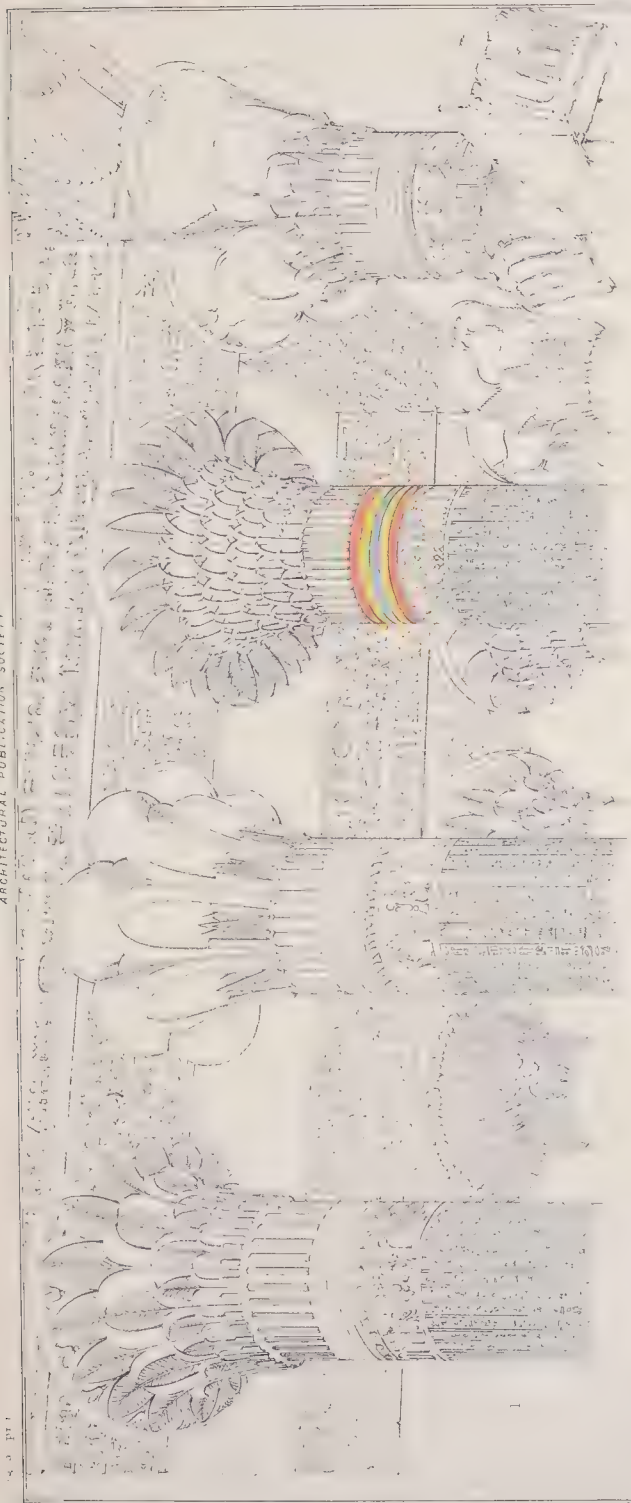


Fig. 1

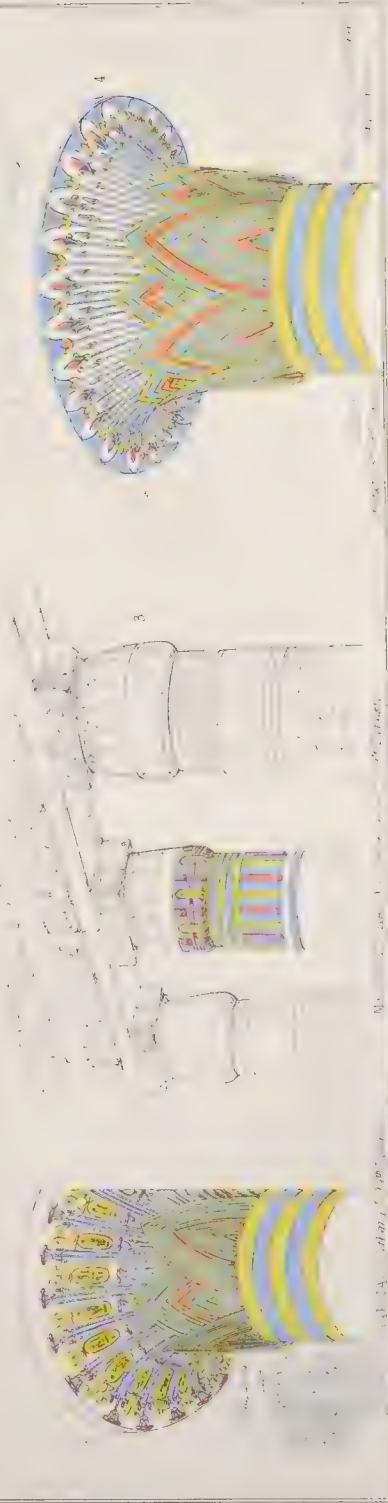


Fig. 2



size: this last was republished, with remarks by WILLIS, at half the scale, by the ARCHÆOLOGICAL INSTITUTE, in *Journal*, 8vo., London, 1848, v, 85. Eginhard, if abbot of S. Maur des Fossés at Paris, as stated in the GALL. CHRIST., was alive in 857: 839 and 844 are the years assigned for his death. RAMÉE, *Histoire*, 12mo., Paris, 1843, ii, 125-8; MICHAUD, *Biog. Univ.*, 8vo., Paris, 1843, s. n. 14.

EGINTON (HARVEY), born in 1809, was a son of Raphael Eginton of Worcester, glass painter, under whom he was educated, with the advantage of studying the cathedral of his native city. He executed a work of magnitude in Wiltshire for H. G. G. Ludlow, Esq. Soon after this (before 1840), through the recommendation of Mr. Britton, he was appointed to restore the parish church of Stratford-on-Avon; and at the same time he restored S. Lawrence church, Evesham: the restoration of Kidderminster church was his last work. At his decease he held the public appointments of county surveyor, of architect to the Incorporated Society for Building Churches and Chapels for the Worcester district, and of architect of the Worcester Diocesan Church Building Society. The following are the principal other edifices upon which he was engaged:—the erection of the churches of Broseley, and Dawley, Shropshire; 1841-2, S. Luke's, Birmingham; 1842, S. Michael's in Bedwardine, Worcester; Westbury, Wiltshire; Malvern Link; Headley Cross; Trimpey; North-hill, Malvern; and S. Paul's, Worcester. The restoration of that at Paulers Pury, Northamptonshire; that at Walton, Warwickshire; and those of Bredon; Clifton-on-Seine; Stoke Prior; Honeybourn; Powick; and Grimley, with Pershore abbey, all in Worcestershire. The erection of Tenbury vicarage; twelve police stations; a house at Malvern; another at Yelverton; schools at Martley; Spetchley; Westbury; and at S. Nicholas, Worcester; a steward's house at Spetchley; glebe houses at Malvern; the extension of Worcester county prison; with the restoration of Sudeley castle, and of Astley hall. He died 21 February 1849, aged 40, having just completed for Mr. Ludlow a church endowed by this earliest of his patrons. *BUILDER Journal*, vii, 101.

EGINUS, bishop of Verona, seems to have been a celebrated architect who practised in Germany, if he were not himself an inmate of the monastery of Salzburg, where S. Rupert was teaching artists. He built about 802 the basilica of S. Peter at Reichenau, at which church he was buried. 68.

EGIS, see *ÆGIS*.

EGL (ANDREAS), mentioned under the date 1436, is the earliest recorded in the list of architects employed upon the cathedral at Ratisbon. 92.

EGMONT (WOUTEZ ARIENSZ) flourished at Rotterdam at the end of the seventeenth century, and designed the West India house in that city in 1695. 24.

EGREMONT STONE. Among the stone quarries, which appear to have been most generally used in the twelfth and following century, that at Egremont in Cumberland is mentioned by TURNER, *Some Account*, 8vo., Oxford, 1851, p. xxiv, who adds, that parts of Windsor Castle were built of this stone, both in the reigns of Henry II and of Edward III: that the groined roof of the "treasury" of S. George's chapel, built by the latter, was of Egremont stone, which cost, rough, 100 s.; *Accounts of Works at Windsor*, 39-40 Edward III: and that considering the difficulty and expense of bringing it by sea in those early times, this material would appear to have been then greatly esteemed. At present it is believed the Egremont quarries are hardly known in the south of England.

This use of the Cumberland stone requires to be confirmed. Egremont stone, identical with the S. Bee's stone, is a soft and easily worked New Red Sandstone, of a pleasant tint and very durable nature. Some beds yield good ashlar stone from 6 to 8 ft. in length; other beds give flags, as part of the rock is laminated.

EGUIGUREN (DIEGO DE) succeeded to M. de Garaizabal in the execution of the parish church at Eybar in Guipuzcoa, ARCH. PUB. SOC.

commenced by H. de Loydi or Loyti, and directed the completion 1635 of the *coro* with its *arco*; the new portal; and other portions. 66.

EGYPTIAN ARCHITECTURE. The extreme antiquity, the vast size, grandeur, and perfection of workmanship, added to the mystery which for ages enveloped the pictured stories that crowd their walls, all combine to render the monuments of Egypt objects of interest and study. To record their triumphs—to hand down to future ages the memory of their long line of kings—to perpetuate their religion, their way of living, their customs—to preserve their dead with an affectionate solicitude for their after memory, appears to have been the constant thought, the principal motive of action, of the Egyptian people at all times. Hence the transport of huge blocks of granite along the whole length of Egypt; hence the rearing such mighty masses as the Pyramids; hence the colossal statues of their princes, and the unwearied toil of hewing out the solid rock for temples and for tombs; and hence the solidity, mass, and simplicity of form which characterize their architecture. Notwithstanding a certain heaviness and absence of variety in the moldings, a squareness and frequent want of proportion, and a constant repetition of particular features, which lasted during the whole period of the Egyptian monarchy, the grandeur and richness of the compositions, the harmonious combination of sculpture, painting, and architecture, the varied play of light and shade, produce on the mind a feeling of awe which can never fail to impress the artistic beholder with the conviction that the world has hitherto produced nothing that in the true elements of the sublime excels Egyptian architecture. The Egyptians, moreover, surpassed all succeeding ages and styles in the power of adapting sculpture to the decoration and illustration of their buildings: their figures, notwithstanding extreme mannerism and incorrect proportions, possess an air of dignity; and in the presence of those mighty colossi which, shattered and ruined as they are, still remain masterpieces of majestic and passionless repose, it is impossible to repress a feeling of awe, such as perhaps neither Greek nor Goth has awakened in the mind. The earliest examples of Egyptian architecture, as might be expected, are the simplest in form; the object sought being stability and durability, the pyramidal form met these requirements most effectually; yet even at the pyramids the stones are squared as accurately and are as highly polished, and the hieroglyphics are cut as sharply, as in the works of the eighteenth and nineteenth dynasties, when Egypt had reached the height of her splendour. The rapidity with which perfection of workmanship was arrived at must therefore have been extraordinary. It is from Egypt that the Greeks derived the Doric column and the triglyph; as they borrowed the Ionic column and the ovolo from Assyria.

For a detailed account of the various erections, of which remains are found along the valley of the Nile from the Delta to the junction of the White and Blue rivers, reference should be made to the publications named at the end of this article, and to the appropriate topographical notices in the Dictionary. The following list merely enumerates the principal structures, arranged according to a chronological sequence of the sovereigns in whose reigns they were erected, but does not enter into any detailed statement of the succession itself; the dates B.C. have been adopted from WILKINSON, unless otherwise mentioned.

FIRST PERIOD.

The pyramid builders (kings of the fourth dynasty), B.C. (3426, LEPSIUS; 3229, BUNSEN).

Khufu or *Suphis I*, *Cheops* of the Greeks, the great pyramid of Ghizeh; *Schafra* or *Suphis II*, *Chephren* of the Greeks, the second pyramid; *Menkara*, *Mycerinus* of the Greeks, the third pyramid. In ascending the valley of the Nile, pyramids are also found at Abou-Roasch, Zauiet el Arrian, Rigah,

Abouseir, and Saccara; at Dashour the two large stone pyramids, with one of smaller dimensions, and two (in crude brick-work considered by LEPSIUS earlier even than the pyramids of Ghizeh, and assigned by him to the period of the third dynasty); while ruins of others are to be found at Lischt, Meidoom, Illahoon, Howara (the pyramid at the labyrinth), Biahmou, and El Koufa. In the same district are numerous tombs and other remains of the same period, sufficient to illustrate the character of the contemporaneous architecture, and to evidence its origin from wooden structures, however much this fact may have been disputed. Diminutive obelisks are also found at this period. In the immediate vicinity of the great pyramids, LEPSIUS examined the ruins of nearly sixty smaller ones, all royal sepulchres, and which tend to prove that the Memphite dynasties endured for several centuries. DASHOOR. NUBIA. PYRAMID, etc.

SECOND PERIOD.

The temple builders, B.C. (2330, LEPSIUS; 2801, BUNSEN).

With the commencement of the Theban line of monarchy in the twelfth dynasty, a new era is at once apparent in the character of the architecture. A series of magnificent temples, palaces, and tombs, enriched with columns, sculpture, and painting to an extraordinary degree, replace the simple form and style imitating structures originally in wood of the earlier period. The pyramid no longer appears, unless it be in one or two isolated cases (as at Saccara and the labyrinth), in evident imitation of the remains of former dynasties in that part of Lower Egypt; but the affection for the pyramidal form manifests itself still in the lofty propylons and in the obelisks, which are two of the great features of the style. The earliest form of column is the plain square pier, such as appears occasionally with a simple bud and papyrus caps of BENIHASSAN and Karnak, to the Isis heads at Sedingah: it is unnecessary to describe fully the more minute characteristics of this style, but it may be added that moldings are of unfrequent occurrence. Excepting a bold cornice to the summit of the buildings, and an occasional torus at the angles or openings, the wall face was left unbroken for the purposes of surface decoration in sculpture or painting. The crowning cornice which is so characteristic of the style, consists invariably of a plain face or architrave, surmounted by a torus, deep cavetto and a fillet; and this simple combination was alone employed, from the period of the sixth dynasty when it first appears, to the latest Roman times, varied only in the surface enrichment and in the proportion it bore to the whole of the building, those of earlier date being less in height and projection than those of the Ptolemaic and Roman eras. The arch of construction is undoubtedly found in more monuments than one erected during the reign of *Amenoph I.* and *Thothmes III.* sixteen centuries before the Christian era: this part of the subject is treated fully by WILKINSON, LAYARD, FERGUSSON, and others.

Twelfth dynasty, B.C. (2330, LEPSIUS; 2801, BUNSEN).

Sesortesen I. obelisk at Mataraeh (Heliopolis); the semicircular-headed fallen obelisk at Begib, near Medeeneh in the Fayoum; the sanctuary of the great temple to Amen at Karnak; and tombs at Benihassan. *Amenemha I.* memorials at Samneh and Benihassan. *Amenemha II.* memorials at Memphis and Benihassan. *Sesortesen II.* tablet at Wadec el Jasoos near Cosseir; memorials at Benihassan and at Samneh. *Sesortesen III.* rock grotto and temple at Sarabut el Khaddem (Sinai), tablet there dated in the forty-third year of his reign; granite statue at Biggeh near Philae. *Amenemha III.* the pyramid at the labyrinth; the labyrinth near Howara in the Fayoum; fortifications and temple at Samneh.

An interval of at least five centuries then followed.

Eighteenth dynasty, after the expulsion of the Hyksos, B.C. (1638, BUNSEN).

Aahmes, Amosis I. of the Greeks, 1575. *Amenoph I.* 1550, enclosed the sanctuary at Karnak in a temple about 120 ft. square; rock temple at Ibrim. *Thothmes I.* 1532, added to temple at Karnak. *Thothmes II.* 1505, hall in front of the sanctuary at Karnak; temples at Kurneh and Samneh; commenced the small temple at Medeenet Haboo. *Thothmes III.* 1495, palace behind sanctuary at Karnak; the obelisks at Karnak dedicated by his sister the regent Num-t-amen to the memory of her father Thothmes I; the colonnade and central chamber at the back of the great court at Karnak; additions to the smaller temple at Medeenet Haboo; two rock temples at Ibrim near Abou Simbel; the obelisk at Alexandria, known as Cleopatra's needle, removed from Heliopolis; the obelisk at the Lateran in Rome, and that in the Atmeidan at Constantinople, both removed from Thebes; restored and added to the temple at Sarabut el Khaddam; commenced the temple at Dakkek (Pselchis), and Kalebshch; restored and added to the temples at Samneh and Kurneh. *Amenoph II.* 1456, commenced temple at Amada; temples at Kalebshch and near Medamout (Thebes); commenced the small palace near the propylons to the south at Karnak. *Thothmes IV.* 1446, completed the temple at Amada; the great sphinx (?). *Amenoph III.* 1430, commenced the temple and palace at Luxor, with the sanctuary, the adjoining chambers, the large colonnade, and the pylon before it; the Memnonium at Goorneh; two colossal statues in the plains, and two edifices near old Goorneh (Thebes); the peristylar temple or mammeisi on the island of Elephantine; two monolithic temples at Silsileh; temples at Soleb and at Sedingah; his tomb is in the Beban el Molook, and that of his queen Taia in the valley behind Medeenet Haboo; a superb portrait sphinx of this monarch, found near the colossal statue, is preserved in the Beaux Arts, S. Petersburg. *Amenoph IV* or *Bach-en-a-ten* (apparently an intruding king); built a city at Tel el Amarna—his name everywhere erased). *Amen-meri-harem-heb* (*Horus* of the Greeks), 1408, continued the works at Luxor, Karnak, and Medeenet Haboo.

Nineteenth dynasty, B.C. (1440, LEPSIUS; 1409, BUNSEN).

Ramses I. 1395, the small temple on southern side of the great temple at Karnak; his tomb is in the Beban el Molook. *Sethi I.* (1385, LEPSIUS) added the great hall of columns at Karnak; began the temple-palace to Amen at old Goorneh (Thebes); the Flaminian obelisk in Rome, brought from Heliopolis; temples at Abydos and at Redesich and the Speos Artemidos; a monolithic temple at Silsileh; his tomb at Beban el Molook was opened by Belzoni 1807, who removed the alabaster sarcophagus, now in Sir John Soane's museum; a cast from the entrance to the tomb is in the British Museum. *Ramses II.* the Great (*Sesostris* of the Greeks), 1355, added to the great temple at Karnak; the Rameseum, erroneously called the Memnonium, or palace-temple at old Goorneh (Thebes); within the area of the palace is a colossal statue in red granite of this prince, its feet are 11 ft. in length; obelisks, etc., to temple at Tanis; his tomb is at Beban el Molook; the pylons and the obelisks (one of which is now at Paris) at Luxor; the colossus at Metra-henny; the ancient Haphestium at Memphis; the temples at Dayr; one with avenue of sphinxes at Wady Saboua; the temple of Osiris at Abydos, where he finished the two great temples; and the rock temple of Abou Simbel; the temple to Pthah at Gerf Hussein, and the rock temple at Kalabshch; the small temple to Hathor at Abou Simbel was erected by his wife *Nefre-areh*. *Merin-ephthah*, 1289, temple at Luxor; the colossal statues of standing figures at old Goorneh. *Sethi II.* 1269, added the great avenue of sphinxes and some of the small chambers to the great temple at Karnak; one of the sphinxes in the Louvre is a portrait statue of this monarch; his tomb is in Beban el Molook; a statue of the king and a cast from the entrance of the tomb are in the British Museum.

Twentieth dynasty. *Mer-rra* or *Ramerra* (1278, LEPSIUS; 1297, BUNSEN), 1255, restoration of temples at Memphis. *Ramses III.* Mei Amen, 1235, added side temple at Karnak;

pylon to temple-palace at old Goorneh (Thebes); and another at Khensu, near the Berket Haboo or Sacred Lake to the south; the pavilion at Medeenet Haboo; built the hypostylar hall at Karnak; his tomb is at Beban el Molook, and his wife's in the valley of Queens.

With this prince the most brilliant period of Egyptian architecture terminated. A long line of princes all bearing the name of Ramses succeeded, forming the twentieth and twenty-first dynasties, who have left no record but their names upon their tombs in the Beban el Molook, and other edifices which they enriched with sculptures or on which they made insignificant alterations. A vigorous monarch appeared occasionally to stem the gradual decline, as *Sheshonk*, the first king of the twenty-second dynasty, the *Shishak* of Scripture, 978, the fine gateway and the outer pylons at Karnak, and the great court there, having been either erected or completed by him. *Tirhaka*, of the twenty-fifth or Ethiopian dynasty, 714-698, records his triumphs in the temple at Medeenet Haboo, to which he added some sculptures, and to the columns in the great court at Karnak. The obelisk now at Monte Citorio in Rome, transferred from Heliopolis by Augustus, bears the name of a *Psametik*, 670-570, of the twenty-sixth dynasty. The tombs of this dynasty are found at Sâ, on the site of the ancient Sais, in the Delta. With these few exceptions, six centuries of gradual but steady decay were terminated by the ruin and desolation caused by the Persian invasion; and the Egyptian temples suffered more at the hands of Cambyzes than from any subsequent invader. There is, however, a temple built in the reign of *Darius Hystaspes* at Heb (El-khargeh) in the Oasis of Ammon.

THIRD PERIOD.

The Ptolemaic or Greek period; or the restorers.

The overthrow of the Persian empire by Alexander released Egypt from this destructive yoke; and under the rule of the Ptolemaic dynasty Egypt, for a time, not only recovered from her degraded state, but was enabled to produce buildings that were splendid and magnificent, though not equal in size or beauty of workmanship to those of the earlier epoch. A reference to the plan of the great temple at Edfoo (APOLLINOPOLIS MAGNA) will give a complete idea of the general arrangement of the temples of this period; but although this dynasty produced many works of great importance, it appears chiefly to have repaired the devastation and ruin with which the Persians overwhelmed the temples and palaces of their predecessors. The following dates are from SMITH, *Diet. Biog.*

Ptolemy Lagus or *Soter*, B.C. 323 (name found at Philæ and Denderah). *Philadelphus*, 285, a temple to his parents; the pharos; the soma at Alexandria; the cities of Berenice Troglodytice, Arsinoë, Berenice Epidiris; commenced the temple of Isis at Philæ; finished the ship canal; the Arsinoëum; an obelisk; the granite temple to Isis at Iseum (Bebayt el Hagar) in the Delta; name found at Karnak and Dakkeh. *Euergetes I*, or *Tryphon*, 247, enlarged the great temple at Karnak; added to temple at Heb in the great Oasis; commenced a small temple at Esneh (Latopolis); built a temple to Osiris at Canopus; inscription at Adule. *Philopator*, 222, temple of Isis at Dakkeh; commenced the small temple at Dahr el Medeeneh near Medeenet Haboo; and added sculptures to that at Pselcis in Æthiopia and at Karnak. The name *Epiphanes*, 205, is found at Denderah, and the Rosetta stone is dated in the ninth year of his reign. *Philometor*, 181, commenced the temple at Edfoo (about 160); continued the temple of Isis at Philæ; built the pronaos at Antæopolis; and the temples at Koom Ombos and Parembolæ. *Euergetes II*, or *Physcon*, 146, built the portico to the temple at Dakkeh (Pselcis); continued the works at the temples at Philæ and Edfoo; restored and completed the sculptures to the temple of Medeenet Haboo, and the temple to Khons at Karnak; and completed the temple at Dahr el Medeeneh. *Soter II*, or *Philometor II*, or *Philadelphus II*, or

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Lathurus, 117, continued the temple at Edfoo; also the works at Medeenet Haboo. *Alexander I*, 107, the enclosing walls of the temple at Edfoo. About this time Thebes was ruined (PAUSANIAS, i, 9). *Alexander II*, 81. *Dionysus I*, or *Auletes*, 80, restored the temple of Medamout, and added the pylons to Dahr el Medeeneh. *Dionysus II*, 51, added the pylons to the temples at Edfoo and Philæ; works at Medeenet Haboo. *Cleopatra*, 43, commenced the temple to Athor at Denderah; and built the mammeisi at Erment (Hermonthis).

FOURTH PERIOD.

The Roman dominion. The Romans carried on the works of the Lagidæ; and the names of the emperors are found in connexion with the monuments to a very late period. But all character and interest are gone, the workmanship is bad, and the hieroglyphics are coarsely cut. *Augustus* continued the works at Denderah, Philæ, and Dakkeh, and raised a temple on the site of an ancient one of the time of *Thothmes III* at Kalebshah; *Tiberius* completed the great portico at Denderah, and added to the sculpture at Philæ. *Hadrian's* name is on the temple of Roman date at Medinet Haboo, which was completed by *Antoninus*, who added the pylon. The latest imperial name after that of *Commodus*, i. e. after 193, found in hieroglyphics is that of *Decius*, 250, at Esneh; but nothing of this era remains of sufficient moment to demand further notice.

After the above period, Egypt can hardly be said to have had any architecture at all until the Mahomedan conquest; the chief buildings after that event are mentioned s. v. CAIRO; SARACENIC ARCHITECTURE.

The most ancient of the Egyptian tombs are raised structures (as the pyramids), and even when partially excavated in the rock, the entrance is invariably built. Tombs of the age of the pyramids are found at Zaueit el Meitan, Berschet, and Ghizeh. During the succeeding period of the Theban or new monarchy, however, the tombs are chiefly hollowed out of the solid rock, sometimes extending to a length of nearly 400 ft.; and it is from the paintings and contents of these marvellous chambers and passages that our knowledge is gained of the arts, history, and customs of the country. The most remarkable of these are the tombs of the kings at Thebes, some of which are decorated with paintings of great beauty and interest; the tombs of the twelfth dynasty at Benihasan and Berschet, in one of which is depicted the transport of the great colossus; and further south are to be found the curious and interesting painted tombs at Elkab, the ancient Eileithyia. At Goorneh, Siout, and Tel el Amarna, are tombs from the twelfth to the twenty-sixth dynasties. Tombs built and vaulted in crude brickwork of the period of the eighteenth and nineteenth dynasties undoubtedly exist, but they are of an inferior class, and all the important tombs of that age are hypogeæ, nor is it till the time of the Psammetichi, in the seventh and sixth centuries B.C., that raised structures in stone are again met with, vaulted moreover in the same material: WILKINSON, *Arch.*

Decoration by colour forms so important a part in the Egyptian monuments, that it seems desirable to add a few words on the subject. Simple colours were most affected, viz. red, blue, and green, black, yellow, and white, the three first being the most frequent combination. The primaries are used invariably with judgment and knowledge. Red and blue are never found in juxtaposition without the separation of a narrow line of white or yellow. Black is invariably contrasted with yellow; gilding is employed sparingly, and generally with considerable taste. The stone was often prepared for the reception of the colour by a thin coat of fine stucco; even the granite obelisk appears sometimes to have been thus treated. The ceilings were not unfrequently painted blue and dotted with stars. The cornices are often found with enrichments painted on the plain face of the stone without any sculptured decoration whatever, and the caps of the columns are treated with a degree of

exquisite taste that it is difficult to equal. A few examples of those from Karnak are given in the *Illustrations*, 1859-60. As far as may be judged from the bas-reliefs and paintings found in the tombs, the domestic architecture of Egypt was scarcely less effective than that of the public monuments. The houses represented therein display elegance and refinement, and were apparently furnished and decorated as carefully as the temples: WILKINSON states they were built of crude bricks stuccoed and painted with all the bright colours in which the Egyptians delighted, and he gives many interesting examples from the tombs; some of which with their painted panels and long slender columns recall to mind the taste of a much later period.

At Tel el Amarna several of the houses are better preserved than the temples, and from their substructions the form and distribution of many of the rooms may be easily traced. Indeed they are calculated to give a more correct idea of the ground plans of Egyptian houses than any in the valley of the Nile. From an attentive examination of several of the Egyptian temples, and particularly that at Philæ, DENON was led to conclude that the general system of construction was first of all to raise the rude mass of the building, and afterwards to proceed to the finishing of the several parts, beginning with the architectural lines, and adding successively the sculptures and hieroglyphical figures, the stucco and the painting. HAMILTON, however, observed in the stone quarries at Silsileh, "several blocks cut out, with half-finished lines of hieroglyphics and architectural ornaments; some intended for entablatures, cornices, small propyla, etc.: enough to cast a degree of doubt on the general truth of the assertion, that their buildings were first raised as rude unformed masses, and the sculptures afterwards executed on the walls"; p. 84.

The walls of the temple are of sandstone or limestone, the shafts of the columns are built up in several pieces, usually semicircular, with the joints broken, and granite, which was employed as a lining to the chambers and passages of the great pyramid, and for the casing of the third pyramid, is otherwise confined to obelisks, statues, doorways, sarcophagi, and apparently to two only of the temples—the granite sanctuary at Karnak, and one at Bebayt in the Delta, which also presents the only example in Egypt of hieroglyphics cut in relief on granite. Basalt was used both for intercolumnar slabs and other architectural members during the twenty-sixth dynasty. The Romans introduced the use of porphyry in the reign of Claudius. On the sandstone hieroglyphics were cut indifferently in relief and in intaglio, the former however being usually adopted for figure subjects until the time of Ramses II, in whose reign intaglio was more frequently employed, and appears henceforth to have been universally adopted, with a slight interruption in the time of the Psammetichi, who endeavoured to restore the low relief of the eighteenth dynasty. The style of both species varied at different periods; sometimes the relief is low and flat, having the edges slightly rounded off; at others the figures stand out in bold relief, and appear almost severed from the wall. The intaglio is often shallow, with the field sunk parallel with the face of the work; or again the field of the symbol is convex, the centre rising flush with the wall, whilst the sides are cut deep into the stone, the outer edge being at right angles with the face of the work. In the reign of Ramses III, a peculiar style of intaglio was introduced, the lower edge of the hieroglyphic being cut in very deep, and the field gradually sloping back from the upper edge, which was flush with the face of the stone, to the extreme depth at the bottom. This style was not followed by any of his successors.

Cairo is still supplied with a magnesian limestone from quarries at Toora-Masarah on the eastern bank; which quarries, in the Mons Troicous, once supplied Memphis and its vicinity, on the western bank, as well as the external portion of the pyramids at Ghizeh; these pyramids otherwise chiefly consisted of the stone from the hills (limestone with nummulites lenticularis), in the neighbourhood; and this last formation has supplied

the rock for the sphinx. The quarries at Silsileh and a few other points in that region furnished the easily worked materials for the superb structures of Thebes, and indeed for most of the temples of ancient Egypt. Although the earliest works were principally erected of limestone, which continued in use occasionally even in Upper Egypt till the commencement of the eighteenth dynasty, yet the Pharaohs of the sixteenth had already introduced the sandstone of Silsileh in the walls and colonnades of the larger temples. Its fitness for masonry, its durability, and its even grain, became so thoroughly appreciated during the eighteenth and succeeding dynasties, that it was from that time almost exclusively used in building the monuments in the Thebaid. "But as its texture was less suited for the reception of colour than the smoother limestone, they prepared its surface with a coat of calcareous composition, which, while it prevented the stone from imbibing an unnecessary quantity of colour, afforded greater facility for the execution of the outlines. The subjects when sculptured, either in relief or intaglio, were again coated with the same substance, to receive the final colouring: and the details of the figures and of the other objects could thereby be finished with a precision and delicacy in vain to be expected on the rough and absorbent surface of the sandstone": WILKINSON, *Handbook*, 259, 411.

This subject cannot be concluded more fitly than in the words of FERGUSSON, *Handbook*. "Taken altogether, perhaps it may be safely asserted that the Egyptians were the most essentially a building people of all those we are acquainted with, and the most generally successful in all they attempted in this way. They understood better than any nation how to use sculpture in combination with architecture, and to make their colossi and avenues of sphinxes group themselves into parts of one great design, and at the same time to use historical paintings fading by insensible degrees into hieroglyphics on the one hand, and sculpture on the other, linking the whole together with the highest degree of phonetic utterance and the most brilliant colouring, thus harmonizing all the arts into one great whole, unsurpassed by anything the world has seen during the thirty centuries of struggle and aspiration that have elapsed since the days of the great kingdom of the Pharaohs."

The following list is of architectural publications:—*Description de l'Égypte*, publié par l'ordre du gouvernement, 8vo. and fol., Paris, 1809; DENON, *Voyage dans la Haute et Basse Égypte*, fol., Paris, 1802; BELZONI, *Narrative of Operations and recent Discoveries*, etc., 8vo. and 4to., London, 1821; GAU, *Antiquités de la Nubie*, fol., Paris, 1823; ROSELLINI, *I Monumenti dell'Egitto et della Nubia*, 8vo., atlas fol., Florence, 1833; CHAMPOLLION le jeune, *Monuments de l'Égypte de la Nubie*, fol.; LEEMANS, *Monuments Égypt. portants des legends royales*, etc., Leyden, 1838; PRISE D'AVENNES, *Monuments Égyptiens, bas-reliefs peintures*, etc., fol., Paris, 1847; PERRING and VYSE, *Operations carried on at the Pyramids of Gizeh in 1837*, fol., London, 1840; FERGUSSON, *Handbook of Architecture*, 8vo., Lond., 1855; ROBERTS, *Egypt and Nubia*, fol., Lond., 1842-50; GAILHABAUD, *Mons. Anciens et Modernes*, vol. 1, 4to., Paris, 1850; WILKINSON, *Architecture of Egypt*, 8vo. and fol., Lond., 1850; *Topography of Thebes*, 8vo., London, 1835; *Manners, etc., of the Ancient Egyptians*, 8vo., London, 1837-46; *Handbook*, 12mo., London, 1847; OSBURN, *Monumental History of Egypt as recorded on the Ruins*, 8vo., London, 1854; LEPSIUS, *Auswahl des ägyptisch Alterthum*, fol., Leipzig, 1842; LEPSIUS, *Denkmäler aus Ägypten* 1., fol., Berlin, 1849-59; HAMILTON, *Ægyptiaca*, 4to., London, 1809; CRYSTAL PALACE, *Guide to the Egyptian Court*; PAPWORTH, *Papers read at the Institute of British Architects*, April 30 and May 21, 1849, condensed in *BUILDER*, *Journal*, vii, 241; POOLE, *Horæ Ægypticæ*, 8vo., London, 1851; DU CAMP, *Égypte, Nubie*, etc., 125 dessins photographiques, fol., Paris, 1852-3.

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EGYPTIAN BLACK MARBLE or Nero antico, see BLACK MARBLE.

EGYPTIAN BRECCIA, see SILICEOUS BRECCIA.

EGYPTIAN GREEN MARBLE (Fr. *verd d'Egypte*), is a 'verd-moderne' marble, consisting of a darkish green ground having grey spots and a little white; it is obtained in quarries at or near Carrara in Italy, which likewise furnished another so called Egyptian green marble having a red ground with clear dark green veins and white network.

EGYPTIAN GRANITE. The name appropriated to a granite having black spots varying in size from a pin's head to a bean, and scattered almost with the regularity seen in 'pudding-stones' on ground called white, but generally slightly tinged with yellowish grey. The extensive ancient quarries which were principally worked in the time of Trajan and of Hadrian, are still visible at Gebel el Fateereh according to WILKINSON, *Handbook*, 8vo., London, 1847, p. 271.

EGYPTIAN HALL. The name given, during the early part of the last century, to several large rooms then constructed, upon the supposition of their conformity to the saloon described by VITRUVIUS, vi, 5, who says that three species of æcus were known, viz. the tetrastyle; the Corinthian with one or more ranges of columns carrying curved ceilings; and the Egyptian, having similar ranges carrying a terrace on joists from the walls to the pillars which supported the upper portion of the room. The top story thus formed had, according to this author, windows between pillars three-quarters of the height of those below; and thus, as he concludes, the Egyptian æcus had some resemblance to a basilica. The so called Egyptian hall in the Mansion House, London, has lost its right to the name by the removal of the upper row of columns. The assembly rooms at York, however, present an example; WOOLFE and GANDON, *Vit. Brit.*, fol., Lond., 1767, i, 78-81.

EHRETIA SERRATA and MACROPHYLLA. Trees of Nepal, East Indies, supply a soft but tough wood, used for posts. Other species in Cuba, called *roble*, give very hard wood. 71.

EICHSTADT, AICHSTADT, AICHSTET, or EICHSTATT. The capital of the district of the same name in Middle Franconia in Bavaria. It consists of the old town with four suburbs, and has as many stone bridges over the Altmühl. Its principal buildings are the cathedral, dedicated to the Virgin and S. Wilibald, commenced 1259, the choir dating 1351, with two towers, some good painted glass, and several fine monuments in bronze and marble, the cloisters, like some Silesian churches, exhibit the uncommon diagonal alternate vaulting, seen in the choir of Lincoln cathedral; the episcopal palace; the castle, a modern structure; the town house, 1440, surmounted by a square tower; two parochial and five other churches, most of which are handsome; a monastery; one or two convents; two schools; and the castle of Wilibald, lately repaired for use as barracks, on a height on the opposite bank of the Altmühl. 28. 50.

EIDOGRAPH. An instrument invented by professor Wallace of Edinburgh, for making a copy, of a drawing, on a scale different to that of the original. It has three centres of motion, and acts by the agency of an endless rope made of watch chain, which is kept in full strain by two equal wheels placed horizontally one at each end of a bar, and each carrying the arm for one of the points; as illustrated in BRADLEY, *Practical Geometry*, 8vo., London, 1834, p. 59. PANTAGRAPH.

EIGTWED (NICOLAUS), colonel of infantry and architect to the king of Denmark, built at Copenhagen a portion of the royal palace; the four palaces with their pavilions which form the *place* in which the equestrian statue of Christian IV was placed; and at Sophienburg the *schloss*; besides supplying designs for many other buildings. He became 1751 director of the Royal Academy of Arts at Copenhagen, and died 1754. A long memoir is given in WEINWICH, *Malers, etc., Kunsten Historie*, 8vo., Copenhagen, 1811, p. 149. 68.

EILEITHYIA or EILETHYIA, or rather *Eileithyiaspolis*. The name of an ancient city, now represented by the village of El-kab, between Esneh and Edfoo in Egypt. Since

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the destruction of a small temple with square pillars, dedicated to Ra by Thothmes III and Amenoph II, the list of the principal remains comprises, besides an isolated cell 20 ft. long and 16 ft. wide, dedicated to Ra by Ramses II, another rather larger and containing four columns, with the name of Amenoph III, which has a paved platform on three sides with an open area in front formed by columns and intercolumnar screens, to which the pylon connected with the temple by a double row of columns forms the entrance. There is also a Ptolemaic temple, dedicated to Lucina by Euergetes II, and partly excavated in the sandstone rock; the front court, made in the reign of Alexander I, is composed as usual of columns with dwarf walls, and opens by a pylon on a staircase of considerable length, having on each side a solid balustrade of masonry. 28.

EINBECK (CONRAD VON) built 1388 the eastern part of the Moritz-kirche at Halle in Saxony. 92.

EINSIEDELN. A village, of the canton of Schwyz in Switzerland, celebrated for its Benedictine abbey (constructed at the beginning of the last century), which is the fifth since the erection of a church and monastery by the first abbot Eberhard, 934, who conducted the works, but confided them 945 to Thietland, who succeeded him in the abbacy 948; STENGEL, *Monasteriologia*, fol., Augsburg, 1619, s. v.

This abbey preserved a celebrated manuscript, afterwards published in MABILLON, *Vetera Analecta*, fol., Paris, 1723, p. 358; it contains the particulars of the travels of some person, now only known as "Anonymus Einsidlensis", who went to Rome in the eighth century, and throws great light on the antiquities and topography of the city at that period. A. A.

EITCHMAIADZIN otherwise ECHMAIZIN, see VAGARCHABAD.

EKEBERGIA. A valuable wood of Gualpara, East Indies, resembling mahogany. E. CAPENSIS, Ash, a wood of the Cape of Good Hope, is tough, and forms planks about 20 ft in length. 71.

EKEL or EKELL was *bauconducteur* to prince Henry of Prussia at Reinsberg 1773-5. 68.

EKTHETES, see EXOSTAS.

ELABORATORY. The old spelling of LABORATORY.

ELÆGNUS HORTENSIS, *olivo di Boemia*. A wood of Tuscany used for furniture. OLEA. 71.

ELÆOCARPUS CYANEUS? A very large tree of Martaban, in the East Indies, used for masts and house posts. 71.

ELÆOTHESIUM, also called ALEPTERION and UNCTUARIUM. In ancient baths the apartment in which the bathers were anointed after leaving the water. In the larger establishments a separate chamber was allotted to this purpose, as shewn in the illustration from the baths of Titus given in the *Detached Essay* BATHS AND WASHHOUSES; at Pompeii, however, the bathers were anointed in the apodyterium, whether that was the frigidarium or the tepidarium itself, or adjoined either of them (LUCIAN, *Hippias*); or was next the hypocaust (PLINY, *Ep.*, ii, 17); or was next the frigidarium and near the ephebeum (VITRUVIUS, v, 11). There is, however, a small long cell rather than room, at the street end of the frigidarium in the thermæ at Pompeii, which might have answered the purpose; and the smallest rooms of this shape in the baths of Caracalla at Rome have received this name.

ELASTICITY. If the form or the volume of a body should be exposed to efforts of a nature to disturb the conditions of equilibrium of its molecules without producing any permanent displacement of the latter, these will tend to resume their former positions, and the body itself will tend to resume its former shape and volume. This tendency of bodies is known amongst authors upon physics by the name of *elasticity*; and the effort necessary to be exerted in order to maintain the changes of form above supposed to be effected, is usually said to represent the *elastic force* of the material in question. This elastic force in fact represents the effort which the body itself makes in returning to its original state, and is the measure of the force

so developed. If the molecules of the body should be disturbed to such an extent that they can no longer resume their original position by their own normal actions, and if the body should be permanently altered in its form by the action to which it has been exposed, the *limit of elasticity* would be said to have been exceeded.

In common language, the terms *limit of elasticity*, *elasticity*, and *elastic force*, are used with considerable laxity, though without sensible inconvenience. Thus a body is often said to be *highly elastic* when its form can be sensibly modified during the period of the exercise of the action, without suffering thereby any permanent change in its outline; and a body is said to be *perfectly elastic* when it resumes its original form in a perfect manner. But it is now generally considered that no such things as *perfectly elastic bodies* exist, and that the most highly elastic ones never exactly resume their original forms after a weight, or action, able to disturb them has been applied.

The elasticity of fluids can only be developed by compression, because their molecules have no definite relative positions to one another. The elasticity of solids may be developed, 1, by traction or tension; 2, by compression; 3, by flexion; and 4, by torsion.

It is generally considered that the laws of elasticity developed by tension are as follows: In the same body the elongation produced by an increased action is directly proportional to the initial tension produced by the original one. It is proportional to the length of the body operated upon. In different bodies it is in the inverse ratio of the transverse sections; DAGUIN, *Traité de Physique*, 8vo., Paris, 1855. From direct experiment, it also appears that if a body be exposed to an action of compression in the direction of its axis, whilst it is maintained in such a position as to prevent any flexion, the body will be shortened in precisely the same degree as would take place if it were exposed to an action of extension in the opposite direction; that is to say that, under equal actions of compression and of extension, the bodies operated upon are shortened and lengthened in equal degrees, so long as the limits of elasticity are not exceeded. It thence follows that the laws of elasticity of compression and of elasticity of extension are identical; and as perhaps the latter are the most frequently brought into operation in architectural works, they are usually those most studied. Very elaborate tables have been published in the various books upon physical science in which the effects of the laws above stated have been represented; but the most important property of solid bodies which architects require to ascertain, of this description at least, is the one known by the name of their *modulus of elasticity*, or the force required to double the original length of a body.

The modulus of elasticity is found generally speaking to decrease in proportion as the temperature increases; and it would appear that the circumstances which tend to increase the density of a body also increase the coefficient of elasticity, and *vice versa*. An electric current will diminish the elasticity of a body in a manner independent of the diminution resulting from the increase of the temperature it may superinduce. The coefficient of elasticity of alloys is found to be sensibly the mean between the coefficients of the metals mixed, irrespective of the changes of volume produced by the fusion. WERTHEIM found also, when tubes are exposed to efforts of either compression or of extension, 1, that the changes of volume are, like the changes of length, proportional to the load; 2, that the variation in the unity of section of a bar, pulled at both ends, is two-thirds of the variation of the unity of length, or the variation of the diameter is equal to one-third; 3, that the variations in the unity of the volume are one-third of the variations of the unity of length; 4, that when the action is exercised upon all the points of a surface, the elongation is one-third of that which would be produced if it were only exercised at the extremities; from this it is concluded, 5, that the variation in the volume of a mass, pressed equally upon all the points of its

surface, is equal to the variation of the unity of length of a bar drawn only in one direction; 6, that if the force be exerted solely at the extremities, and the change of diameter be opposed in any way, the variations will not exceed two-thirds of the unity of length; and finally, 7, that the molecular force of elastic bodies decreases in the inverse ratio of the fourteenth power of the distance. It may be inferred from these observations that, if a tube be compressed or extended by forces applied to the two extremities, it will be necessary to vary the forces, in order to produce the same change of length, 1, when it can change its diameter; 2, when it cannot so change; or 3, when the effort is applied over the whole surface; in the proportions of $1 : \frac{2}{3} : 3$. For the same force, the variations will be $3 : 2 : 1$ respectively.

The principal laws of elasticity of flexion appear from the researches of COULOMB, WERTHEIM, and others, to be as follows: 1. If a bar of a rectangular section, fixed by one of its extremities in a horizontal position, be loaded at the other end, it will be found that the deflection of the end of the bar will be proportional to the load. 2. The load required to produce a certain deflection is always proportional to the width of the bar. 3. This load is directly proportional to the cube of the thickness or depth of the bar, and it is in the inverse ratio of the cube of the length.

The elasticity of torsion, as developed in bodies whose molecules admit of a certain degree of displacement, is considered to follow the subjoined laws: 1. The force of torsion is equal to the angle of torsion; or, in other words, the force which it is necessary to apply to the end of a lever whose length is equal to unity, and which acts perpendicularly to the direction of the body experimented upon, is equal to the angular quantity traversed by the lower radius of that body considered with reference to a radius of its upper end. 2. The force of torsion remains the same, whatever may be the tension of the body. 3. The coefficient of torsion, or the ratio of the arc described by the extremity of the lever compared to unity, is in the inverse ratio of a suspended body operated upon. 4. The coefficient of torsion in a suspended body is equal to the fourth power of the diameter. It has been observed that, if a weight be suspended by a metallic rod, and if the weight be gradually increased, the positions of the axis will differ according to the increase of the weight; even to such an extent as under some circumstances to exceed a complete revolution. Moreover, when a rod bearing a certain weight oscillates upon its own axis by the elasticity of torsion, the amplitude of the oscillations continually decreases, and the movement will at last cease altogether. The above laws were established by COULOMB from the result of his experiments on metallic cylindrical rods; but they have been shown by the direct experiments of POISSON, CAUCHY, and SAVART, to be equally applicable to rods of a rectangular or any other section, and to every description of material.

The limits of elasticity of either of the above named classes are said to be exceeded, when the body exposed to an action likely to call their laws into existence suffers an alteration of form of a permanent character. It has been found by direct experiment that the limit of the permanent elongation becomes more nearly attained in proportion as the temperature increases; and that, if a bar be twisted so as to pass the limit of elasticity, it will assume a permanent torsion, the limit of which increases rapidly at first, and more slowly afterwards. If the force able to produce a permanent change of condition of the length only should act for a long time, the bar exposed to its influence will continue to extend; and therefore it becomes necessary in practice to observe the effects produced upon the elasticity of bodies by instantaneous or by permanent weights. Bodies of any description subjected to a weight acting in the direction of their length finally break under a certain load, the minimum amount of which for any particular body is said to be its *tenacity* or *absolute resistance*. This tenacity

seems to follow the laws, 1, that the weight able to produce rupture is proportional to the section of the bar; 2, that it is independent of their lengths. Nevertheless, long bars of metal break more easily under loads than small ones do; and very fine threads, or drawn bars, bear a greater comparative weight than bars of a greater diameter. Fibrous bodies resist more successfully in the direction of the fibres than when the effort is applied transversely to the fibres.

MUSCHENBROECK, THOMSON, GUYTON-MORVEAU, are among the older writers upon physical science who have treated the subject with the greatest detail; but WERTHEIM's recent researches appear to be those most worthy of adoption by practical men. RESISTANCE OF MATERIALS; RUPTURE.

TABLE I. Tenacity of Bars of Metal, two millimetres (0.078 in.) in diameter, expressed in English pounds Avoirdupois, as ascertained by WERTHEIM and GUYTON-MORVEAU.

Iron wire	-	550.19	Gold	-	150.11
Copper	-	302.00	Zinc	-	109.74
Platinum	-	271.04	Tin	-	34.71
Silver	-	187.90	Lead	-	12.40

TABLE II. Tenacity of Woods per inch sectional area, in English pounds Avoirdupois, as ascertained by MUSCHENBROECK.

Oak	-	853 to 1137	Beech	-	1137
Aspen	-	853 to 995	Box	-	1991
White fir	-	1137 to 1380	Pear tree	-	853
Ash	-	1706	Mahogany	-	711
Elm	-	1470			

TABLE III. Tenacity of Metal Rods, one millimetre (0.039 in.) diameter, at different degrees of temperature, according to researches by WERTHEIM; MOSELEY, Engineering and Architecture, &c., London, 1843.

Name of Metal.	Gradual Rupture.	Sudden Rupture.	At 212°.	At 320°.
Lead, cast	1bs. 2.75	1bs. 4.80	—	—
" drawn	4.55	5.19	—	—
" second melting	8.92	4.40	1.18	—
Tin, cast	7.48	9.15	—	—
" drawn	5.30	6.47 6.61	—	—
" second melting	3.74	7.85 7.96	1.87	—
Cadmium, drawn	4.93	—	—	—
" second melting	—	10.58	5.72	—
Gold, drawn	39.40	55.52 62.45	—	—
" second melting	22.17	24.20 24.42	27.72	26.53
Silver, drawn	63.80	65.12	—	—
" second melting	35.24	35.86 36.50	30.60	30.80
Refined zinc, cast	3.30	—	—	—
Common do., drawn	28.16	31.09	26.81	16.00
" second melting	—	5.81	—	—
Palladium, drawn	—	—	—	—
" second melting	60.28	—	—	—
Copper, drawn	88.66	90.20	—	—
" second melting	67.19	69.41 69.69	48.02	—
Platinum, drawn	75.02	77.00	—	—
" second melting	51.70	50.76 60.94	49.72	43.31
Iron, drawn	134.12	137.50 143.22	—	—
" second melting	103.14	110.55	112.42	103.18
Cast steel, drawn	—	184.36	—	—
" second melting	144.54	—	—	—
Steel wire, drawn	154.00	188.98 218.02	—	—
" second melting	88.40	118.58	130.02	112.00
Antimony, cast	—	1.43	1.54	—
Bismuth, cast	—	2.13	—	—

TABLE IV. Average lengths of Bars of different Metals which would break under their own weight, if one end were fixed and the other left free; the lengths being calculated upon the principle that the breaking weight $P = Ld$, in which L = the length, and d = the specific weight of the bar (DAGUIN).

Iron	-	1804	Tin	-	161
Silver	-	843	Bismuth	-	74
Brass	-	525	Zinc	-	30
Gold	-	394	Lead	-	16

TABLE V. Modulus of Elasticity of various Materials.

Ash	-	1,644,800	Lead, cast (English)	-	720,000
Beech	-	1,353,000	Marble, white (Italian)	-	2,520,000
Birch	-	1,062,400	Oak (English)	-	1,451,200
Brass, cast	-	8,930,000	Do. (Dantzic)	-	1,191,200
Deal (Christiansburg middle)	-	1,672,000	Do. (African middle)	-	2,283,200
Ditto (Memel middle)	-	1,595,200	Pine, pitch	-	1,293,600
Elm (seasoned)	-	609,840	Do. red	-	1,840,000
Fir (New England)	-	2,101,200	Do. American yellow	-	1,600,000
Ditto (Riga)	-	1,328,800	Slate, Welsh	-	15,800,000
Iron, cast, Old Park	-	18,014,400	Do. Westmoreland	-	12,000,000
Do. Carron No. 2, cold blast	-	17,270,500	Steel, razor-tempered	-	20,000,000
Do. do. do. hot blast	-	16,065,000	Tank, dry	-	2,434,400
Do. Coed Talon, No. 2, cold blast	-	14,513,500	Tin, cast	-	4,698,000
Do. do. do. hot blast	-	14,322,000	Whalebone	-	8,200,000
Larch	-	807,000	Zinc	-	18,080,000

G. R. B.

The CIVIL ENGINEER *Journal*, 1850, xiii, 294, gives an account of a paper read to the British Association by RANKINE, *On the Laws of the Elasticity of Solids*; and in the same *Journal*, 1843, vi, 355, is an abstract of a paper read to the

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same body by HODGKINSON, *Experiments*, to prove that all bodies are in some sense *inelastic*, or have a defect of elasticity, i. e. a set, commencing immediately with the application of a strain, however slight, although this set had not been previously noticed except when the strain had been considerable, e. g. one-third or upwards of the breaking weight. In the same *Journal*, 1848, xi, 259, it has consequently been stated by Cox, *Notes on Engineering*, that the actual deflections of beams are somewhat more than the theoretical law would make them; and that this discrepancy may be accounted for by attributing it to the defect of elasticity, which the ordinary theory of beams does not consider: and citing HODGKINSON, *Researches in Cast Iron*, 4to., London, 1840, he proceeds to urge that if this defect of elasticity is small in cast iron girders, this is by no means the case in jointed structures composed of several parts connected by rivets or bolts, and that this distinction should always be taken into consideration, for the neglect of it would lead to very erroneous conclusions regarding the strength of structures of the latter kind: as cases in point, may be instanced calculations respecting the strength of girders formed in three pieces and supported by tension rods: he adds that formulas which determine the strength of simple unjointed girders are inapplicable to these structures, and are not likely to give even an approximation to the amount of their real strength. A paper by the same author, *The Hyperbolic Law of Elasticity*, read to the British Association, and given in the same *Journal*, 1850, xiii, 297, criticises the formula (1) adopted in the REPORT of the Commission, 1849, *On Iron in Railway Structures*; and ends with the preference of a hyperbolic to a parabolic law of elasticity or deflection; and with the following passage, "the great desideratum, for the improvement of the hyperbolic, or any hypothetical, law of elasticity, is a knowledge of the manner in which the strength of cast metal is influenced by the magnitude of the casting; and it is to be hoped that this defect of practical knowledge will not long remain unsupplied."

EL-BALAD. An ancient city, perhaps representing Thialamath, near or at Dofar, about the centre of the southern coast of Arabia: although tradition ascribes its foundation to the middle of the twelfth century, a space of two miles in length and 1,800 ft. in width is said to consist of extensive mounds of loose hewn stones, still supporting groups of columns, as well as fragments of sculptured decorations of capitals, etc., with some troughs used for baths, all formed of freestone. 50.

ELBOW. An angle formed by two perpendicular planes; NEVE, *Dict.*, 1736, however, explains it as 'an obtuse angle of a building or wall, dividing it from its right line.' It is also used for a short return from the face of a wall; in other words, the side of any shallow recess. GWILT, *Encyc.*, restricts it to 'the upright side which flanks any panelled work, as in windows below the shutter'; in which he merely follows STUART, *Dict.*, s. v.; and in joiners' work it certainly does only mean the jamb, below the shutter boxing, forming an elbow with the window back.

ELBOW of an architrave, see EAR.

ELBOW (Fr. *accoudoir*) is the usual term for what has also been called the arm-rest of a stall or seat. These elbows are of greater rarity and more interest than poppy heads, and they had quite as much attention bestowed upon them in the middle ages. They were chiefly formed of grotesque heads, of animals, or of foliage, well rounded in the upper part, out of due regard to the purpose for which they were intended. Four examples are given in the BUILDER *Journal*, 1848, vi, 3 and 67, which justly cites the examples in the cathedral at Winchester. APPODIATORIUM. STALL.

ELECTRO-CHEMISTRY or ELECTRO-METALLURGY. The branch of science which investigates the quantity and intensity of electrical or galvanic action upon metals. All metals, in ordinary circumstances, possess a definite galvanic character; and when any two metals are exposed together to an exciting fluid (air or moisture is sufficient), a galvanic

action is immediately generated; the electro-positive matter being gradually destroyed, whilst the electro-negative material is protected by the action which destroys the positive one. The effect of this action may be noticed upon iron-work connected with lead,—a metal negative to iron; after long exposure, the harder material will be found much more wasted upon the portions touching, or near, the lead than elsewhere; this decay, generally attributed to the mere absorption of oxygen, arises from the galvanic action induced by the two metals in contact, and at the expense of the more positive one. Thus zinc and copper, placed in connexion in an exciting fluid, produce a galvanic battery; the positive metal, zinc, being destroyed. Zinc is galvanically positive to all metals, and by reason of this quality protects them while in contact with them, *i. e.* until it has wasted away, which, in its application to building, it does very slowly; because when exposed to air or placed in water its surface becomes covered with a grey film of sub-oxide, which does not increase, and this film is better calculated to resist the mechanical and chemical effects of other bodies than the metal itself. Thus, while zinc has the property of protecting other metals, its own decay is prevented by its oxide, which exists only in a thin film, is insoluble in water, and is not easily removed. These properties have long been known, but the obstacles in using them have been the high price of pure zinc, and the difficulty of applying it in a pure state to iron, except by deposition. Impure zinc is of little or no value as a protection to other metals, because the adventitious matters being all electro-negative to it, galvanically operate to its destruction; and there is, perhaps, no other secure method of obtaining pure zinc than by deposition, *i. e.* electrolysis. It would be desirable to ascertain whether the decay of the copper covering of the recent wrought-iron roof to the cathedral at Chartres was caused by any such action. Great facilities have been given of late for the use of artistic sculpture in details of architectural works, by the production of a deposit on a clay model or in a black-leaded mould; metallic cloth, impervious to water, has been obtained. The most important applications, in practice of the theory of electrotyping, have occurred at the cathedral of S. Isaac in S. Petersburg, where the dome was silvered, and the original clay models of the colossal statues were bronzed by deposition. MILLER, *Recent Researches*, of which an abstract is given in the *CIVIL ENGINEER Journal*, 1844, vii, 207, and contains, p. 74, most of the above remarks as extracts from a work by ELKINGTON, and mentions, p. 239, Schottlaender's patent for the deposition of metals upon felt and other fabrics. NAPIER, *Manual*, 8vo., London, 1848; NOAD, *Lectures on Electricity*, 8vo., London, 1849; and *Manual*, 8vo., London, 1855-7; WALKER, *Electrotype Manipulation*, 8vo., London, 1850; SMEE, *Elements*, 12mo., London, 1851; FARADAY, *Experimental Researches*, 8vo., London, 1859.

ELECTRO-BRONZING. A process, which, as first exhibited to the Académie des Sciences at Paris by M. de Ruolz in 1841, was too expensive; it was not until 1848 that MM. Brunel, Bessin, and Gauguin explained to the same body their composition, reported in the *CIVIL ENGINEER Journal*, xi, 127, 1848, of cheap solutions of brass and also of bronze, by means of which a coating of these metals could be given to iron, lead, zinc, tin, and alloys of these metals with one another, or with bismuth or with antimony. In 1844, the same *Journal*, vii, 74, noticed the somewhat similar receipts published by Messrs. Elkington, and in 1847, x, 292, is recorded the composition of the apparently inexpensive solutions, and the various processes patented in England by MM. Piaget and du Bois for coating models with copper, gold, or silver. Some curious changes in electric-conductor wires are noticed in the same *Journal*, 1845, viii, 163, which show the reason why brass work will not last in conservatories.

ELECTROTYPE. A metallic precipitate from a solution,

by means of a galvanic current, upon a model either in relief or in intaglio, or upon a mould. The theory was discovered by Mr. Spencer, lately of Liverpool, and was applied by him as early as 1838 for the reproduction of medals, copperplate engravings, etc.; and subsequently the principles upon which Mr. Spencer's invention was founded, have been extended to other branches of the arts by the researches of Jacobi, Hulot, Becquerel, and others. In electrotypes, as now practised, the model is if possible formed in metal, or in a substance able to conduct electricity, and a reverse mould of it is taken by precipitating a metallic solution upon its surface; or if the model be made in plaster, a mould of wax, gutta-percha, sulphur, etc., taken from it, must be coated with black lead; or in case of gold or silver solutions, with phosphorus; the solution required for the copy is then precipitated by means of a current of electricity, upon the mould immersed in the solution. BECQUEREL, *Traité d'Electricité*, 8vo, Paris, 1855, ii, 247. G. R. R.

ELEITHYIA, see ELEITHYIAS.

ELEJALDE (DON JOSEF DE) received from J. S. Bort, and executed 1769, with some variations of his own, the design for the front of the cathedral at Lugo in Galicia. 66.

ELEMENTS OF DESIGN, see *Detached Essay*.

ELEPHANTA, in Hindostani *Gerapori*. An island near Bombay, which received its modern name from the figure of an elephant carrying a tiger, cut out of an insulated black rock, and formerly standing near the usual place of landing. This island, celebrated for its cave temples, is about five miles in circumference, and consists of a valley between two long hills, well covered with wood, and supplied with water. The cave usually described, and situated about six furlongs from the elephant, is about 133 ft. long from the east to the west entrance, 130 ft. wide, and from 15 ft. to 17 ft. 6 in. high, as the ceiling does not correspond to the level of the floor. The rock here is much harder than at ELLORA, and all the details are cut with more precision, and are better preserved, than in the caves there; but neither the outline nor general design is better than in the sculpture of the Hindu series there. Sixteen pilasters and twenty-six columns were originally left to appear to sustain the ceiling, but eight columns were destroyed chiefly by a Portuguese, with a cannon, while the island was in the possession of his nation. The great cave resembles that called Doomar Lena at Ellora in size, plan, and detail; that however is the largest, being 150 ft. each way; the pillars are so much alike that it requires drawings made on the spot to detect the difference between them. Both temples are ascribed by FERGUSON, *Illustrations to the Rock-cut Temples of India*, 8vo, London, 1845 (he does not illustrate Elephanta), to the tenth century; both exactly resemble in plan the chañri, such as that in front of the great temple at Barolli; but the cave in question differs from that at Ellora in the position of the Ling chapel, or sanctuary, and in the possession of a trimurti, or three-formed idol. In the *Transactions of the Literary Society of Bombay*, 4to., London, 1819, i, 198, ERSKINE, *Account* (who also supplies a list of works which had been published upon this subject), gives a plan of the excavation, as well as a description of the elephant, and views of the sculptures and of one of the columns, which last is carefully described, p. 213, with a curious note, p. 248, of the manner in which a portion of one cushion had been added by means of two plugs of teak-wood; and another, p. 250, as to the existence of a set of unvisited caves. Of these excavations FERGUSON says, that in a ravine running from the great cave across the island, there are two other caves similar in plan to those situated between the Kylas and Doomar Lena at Ellora; they "are so much injured by the falling of the rock and the damp, that it is impossible to make out more than their dedication to Siva, and a general similarity to those of Ellora, with which I have no doubt they are contemporary: indeed there is a degree of similarity between the two series which is singular in structures so distant, and which can only be accounted

for by their being undertaken at the same time, and probably under the same direction." The same author, speaking of the caves numbered 6 and 7 at Ajunta, notices that their architecture is interesting, as the pillars have the same cushion capitals as, and are extremely similar to, those found at Elephanta, in the Doomar Lena at Ellora, and at Salsette, as well as in one of the caves at Kannari; and that these works are probably not far distant in date; while, "though something like them is found in the buildings of the south of India, nothing of the sort exists, that I am aware of, in any structural building to the north of the Nerbudda." While the caves at Dhoomnar and Ellora contain, however, a strong admixture of Brahmanism with Buddhism, those at Elephanta are entirely Brahmanical. The chief other illustrations are given by GOLDINGHAM, *Some Account*, in the Asiatic Society's *Researches*, 4to., Calcutta, 1795, iv, 407; FORBES, *Oriental Memoirs*, 4to., London, 1813, i, 419-54; DANIELL, *Oriental Scenery*, part 5, fol., London, 1815, pl. 7 and 8; and four views in GRINDLAY, *Scenery, etc., of Western India*, fol., London, 1826. There is also a paper on Elephanta by HUNTER, in the *ARCHÆOLOGIA*, 4to., London, 1785, vii, 286.

50.

ELEPHANTINE (in Arabic Djesiret-el-Sag). The ancient name of an island in the Nile, opposite to Assouan, in Egypt. It appears that the town which it contained possessed at one time sufficient power to give a line of kings to Upper Egypt and Memphis, and probably, like the realm of This (Abydos), declined as Thebes arose. The most remarkable works on the island were, on its north side, a temple supposed to have been dedicated to Ammon, and altogether about 40 ft. long by 26 ft. wide, consisting of a single chamber with two columns in front and back of its portico, and seven square piers on each flank: on the south side of the island there was another temple of similar design, about 40 ft. long and 32 ft. wide, apparently dedicated to Kneph, and built or completed by Amenoph III: both of these buildings were each remarkable for being constructed upon a high basement, and for having the vertical faces not inclined as usual in Egyptian work, but perpendicular. The latter edifice afforded a curious example of ancient proportions regulated by a module which was half the diameter of the column, and for having the rebated jambs of its doorways splayed. These buildings are given, with a map of the island, in the *Descr. de l'Égypte* (Antiquités), i, pl. 31-8, (texte) i, 175-213; with a Nilometer, described by WILKINSON, *Manners and Customs*, 8vo., London, 1837-46, 2nd series, i, 47. The upper part of this latter structure was destroyed 1822, when the other remains, inclusive of part of a gateway (of the time of Alexander) constructed of the granite which forms the island, also suffered to afford materials for the pasha's palace at Assouan. Several indications of ancient houses, quays, etc., also exist.

28. 56.

ELEUSIS. The ancient name of a city in Attica, now called Eleusina, or more commonly, Lessina and Lepsina. The remains of an aqueduct, and other vestiges of its former importance, are described in the *Transactions* of the Royal Society of Literature, 4to., London, 1829, i, 221, by LEAKE, *Demi of Attica*, who chiefly has been followed in this notice. Indications of a sacred way from Athens terminate at a large pavement between the ruins of the temple to Artemis Propylæa, and, fronting it, the remains of a propylæum that was very nearly of the same plan and dimensions as that of the Acropolis at Athens. This entrance was connected with the outer wall of the enclosure to the *anaktoron*, *hieron*, *megaron*, or *telesterion* of Demeter. At a distance of 50 ft. from the first gate was a much smaller one (32 ft., wide between two parallel walls 50 ft. long) belonging to the inner or pentagonal peribolus; towards the inner extremity this opening was narrowed by transverse walls to a gateway 12 ft. wide, that was decorated with ante, opposite to two columns of an Ionic order. Between the inner front of this propylæum and the site (now occupied by the modern village) of the great temple, laid, until

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1801, the colossal bust crowned with a basket, of Pentelic marble, which is now at Cambridge.

The temple of Ceres or Demeter was the largest in Greece, and with those of Jupiter Olympius at Athens, of Apollo at Didymæ, and of Diana at Ephesus, formed the quartette of renowned marble temples, according to VITRUVIUS, vii, pref., who states that the building was first constructed by Ictinus, about B.C. 440, and that the exterior portico was not erected by the architect Philo until about B.C. 318: but PLUTARCH, s. v. *Pericles*, says, that Corœbus began the work, and proceeded so far as the erection of the lower columns with their entablature or epistylum; that at his death Metagenes added the gallery, or diazoma with the upper columns; and that Xenocles, τὸ ὀρθαῖον ἐχορῶφωσε, which has been interpreted, constructed the lacunaria, but more properly should be rendered, roofed over the then void space. It should be noticed that the dodecastyle Doric portico had the shafts of the columns, about 6 ft. 6 in. in diameter, fluted only at the extremities; that the building faced the south-east; that the platform at the back of the temple was 20 ft. above the level of the pavement of the portico; and that a flight of steps on the outside of the north angle of the structure led up to a point on this platform, not far from where another flight ascended still higher to a portal with two columns, which was probably a small propylæum between the hieron and the acropolis.

Referring for descriptive particulars to CHANDLER, *Travels*, 4to., Oxford, 1776, the SOCIETY OF DILETTANTI, *Antiquities of Ionia*, fol., London, 1797, ii, pl. 18-20, gave a Doric entablature, with some lacunaria, which were afterwards found to have belonged to the large propylæum, and the Doric entablature of the cella, with a sketch of its general plan. These plates were superseded when the same society, in *Unedited Antiq. of Attica*, fol., London, 1817, gave a plan of the city, another of the ruins to a larger scale, and views of two modern churches, and a Corinthian capital of peculiar design, besides detailed illustrations of the larger propylæum, especially of its painted ceiling, and of its interior (Ionic) columns; the total height of the orders was not ascertained. To these are added the plan of the small propylæum, with details inclusive of the capitals (unfinished at back), of its two Ionic columns, of its antæ with the well-known capitals, and its ceiling. Besides these, the same work shows the ascertained features of the great temple, with a restoration that supposes the cella to have been 167 ft. deep by 166 ft. 6 ins. wide, with twenty-eight columns disposed in two double rows across the cella, one near the front, the other next the back: FALKENER, *Museum*, etc., 8vo., Lond., 1851, i, 173, has suggested a different arrangement; but neither seems to supply the diazoma mentioned by PLUTARCH. In this case also the total height of the Doric columns was not ascertained, although there are suggestions in the following plate for a longitudinal section showing an interior Doric order supporting smaller columns, as at the Parthenon and at Pæstum. These plates are followed by similar details of the temple, distyle in antis, to Artemis Propylæa, which is chiefly remarkable for having the raking members of the pediment continued along the flanks. None of the buildings at Eleusis were wholly finished, although described by PAUSANIAS in the first century A.D.

ELEUTHEROPOLIS. The name assigned to the ruins of an ancient city which surround the village of Beto Gabra or Beit-Jibrin, in the south-west plain of Judæa. They represent ancient walls and dwellings, a church of strong and beautiful masonry, a fortress encompassed by a strong wall of uncemented large square stones, and numerous vaults with semicircular arches.

50.

ELEVATION (It. *alzato*, in *piedi*; Sp. *alzado*; Fr. *élévation*; Ger. *aufriß*). A geometrical representation of the front of a building or of part of a building. The old explanation as "the description or draught of the face of the principal side of an edifice, called also the 'upright,'" has in later times yielded

to "a geometrical projection drawn on a plane perpendicular to the horizon." *ANGLE OF ELEVATION. ORTHOGRAPHIA. 1. 2. 4.*

ELEVATOR, see LIFT and SCAFFOLD.

EL-GEMM in Tunis. The modern name of *THYSDRUM*.

ELGIN. A royal burgh, the capital of the county of the same name, or Morayshire, in Scotland. It extends for nearly a mile in length on the south side of the river Lossie. There still remain many dwellings of the mediæval and later periods which present quaint architectural peculiarities; many of the houses are ranged in the old French manner round square courtyards, communicating with the street by low heavy browed arches, which were frequently part of an open piazza formed by pillars and arches under the front wall. Some niches, still marking the spots where a statue of the Virgin with a lamp was formerly placed, attest the antiquity of the street architecture of Elgin. One illustration of such houses is given in *BILLINGS, Baronial, etc., Antiq., 4to.,* Edinb., 1842-52. The (former) cathedral, once the most magnificent in the country, and called 'the lantern of the north', had its foundation stone laid 19 July 1224, on the removal of the see from Spynie, a few miles off, and is said to have been finished in eighteen years. The edifice was much damaged by fire 1270, yet the greater part of the present remains belong to the Romanesque and First Pointed periods; of the latter it is the purest specimen in Scotland. *BILLINGS*, who devotes eight plates to it, suggests with apparent reason that the portions now deficient were the works constructed after another fire 1390: in 1402 it was plundered: in 1568 the leaden roof was removed, and the consequent state of ruin commenced: the stones of the walls of the tower becoming loose (from the decay of both stone and lime), the Office of Woods and Forests in 1855 caused the decayed stones to be replaced and the walls cemented; *BUILDER Journal*, xiii, 485. Among the chief features are the great portal, the magnificent double row of lancet windows at the east end, the Flamboyant character of the windows to the aisles, the octangular chapter house which is nearly perfect (it is locally called the 'Prentice aile', from a legend like that at Roslyn), the remains of the vestry, and the small sacristy containing a lavatory well carved. There were six bays in the nave; the windows of the choir aisles are not gabled, but it is probable that the outer row of the aisles of the nave were so, being perhaps the only example in Scotland of such treatment.

The following dimensions have been obtained for this article. Length inside 259 ft.; over the walls 267 ft.; over doorway 272 ft. 6 ins.; breadth within the walls 82 ft.; of the nave 27 ft. 4 ins., and over, 35 ft.; north aisles, inner and outer 10 ft. each; south aisles, inner 11 ft. 8 ins.; outer 8 ft. 4 ins.; length of transepts 105 ft. within; diameter of nave pillars 4 ft. 10 ins., and of aisles 2 ft. 6 ins. The height of the west towers is 84 ft.; and of the side walls 41 ft. The chapter house is 35 ft. wide on the square, and 37 ft. on the diagonal; the circumference of central pillar 8 ft. 6 ins.; its height to top of the capital 20 ft. 4 ins.; and of the walls 33 ft. Of the five lower east windows, each 2 ft. 2 ins. wide, the height to the top is 15 ft.; to springing 11 ft. 3 ins.; the heights of the second row are 10 ft. 9 ins. and 8 ft. respectively; the round east window is 12 ft. in diameter; and the west window is 19 ft. wide and 26 ft. 6 ins. high. Illustrations were published in Elgin about 1829 by J. Grant; these are now rare: but photographic views are to be obtained, as well as stereoscopic ones, by Wilson of Aberdeen. Adjoining the cathedral stand the ruins of an old plain domestic looking building, said to have been the bishop's town residence; his palace, a noble castellated edifice, is situate at Spynie.

The other chief buildings comprise the parish church (Grecian), with a Doric portico, and a tower finished after the model of the Choragic monument, by the late A. Simpson of Aberdeen; who also designed the Anderson institution (Grecian): the hospital, forming the western termination of the High-street, with a dome, by W. Burn; two Free churches, Secession church, English church, and Roman Catholic chapel,

are all Gothic; the latter and the museum (Italian) are two of the early works by the late T. Mackenzie of Elgin; the South Free church and the Secession church are by Messrs. Reid of Elgin; who also designed the royal bank and North of Scotland bank; the union bank, by Messrs. Mathews and Petrie; and the commercial bank, railway hotel, and markets, by Messrs. Mackenzie and Mathews: the court house, assembly rooms, gaol, and several educational establishments, and numerous villas, are also among the modern buildings. Sketches are given in the *BUILDING CHRONICLE*, 4to., Edinb., 1851, 210, which also, 235, gives a restored elevation of the east front of the cathedral, from measurements by J. J. Laing. J. M.

ELIAS, see ELYAS.

ELIGIUS (SANCTUS), a goldsmith who was consecrated bishop of Noyon, 640 or 665, is mentioned by *RAMÉR, Hist.*, 12mo., Paris, 1843, ii, 119, with the following terms, "son biographe parle des honoraires que touchait le saint évêque pour ses ouvrages"; but on reference to *S. AUDOENUS, Vita*, and to the *GALLIA CHRISTIANA*, fol., Paris, 1751, ix, 982, no passage was found which appears to mean that S. Eloi was the architect of the buildings which he or his disciples may have founded.

ELIS. The ancient name of the capital of a district called Elis on the western coast of Peloponnesus. A hill now called Kaloskopi (It. *belvedere*) about 500 ft. high was the site of the acropolis, and some houses in detached villages having the general name of Palæopoli occupy the place of the town. Of the latter nothing remains visible except some masses of brickwork: an account, with plans, etc., and a map of their position by T. Allason, is given in *STANHOPE, Olympia*, fol., London, 1824, p. 51-4.

ELIZABETHAN AND JACOBEOAN or REVIVAL ARCHITECTURE. Elizabethan architecture is that modification of the Italian style which, in England, succeeded to the Tudor development of mediæval art. Elizabethan architecture agrees in style with the *Rinascimento* of Italy; the *Plateresca* of Spain; the *Renaissance* of France; and the *Renaissance* of Germany.

The name English Renaissance has also been given to the style, but it is perhaps more applicable to the grander manner of Italian architecture introduced by Inigo Jones and his immediate successors. The cinque-centist sculptors of Italy brought their art with them into England early in the reign of Henry VIII, but it was only occasionally adopted until the erection of Somerset-place, London, 1546-49, from which time it became gradually developed and employed throughout England. The introduction of other continental artists (no French name has been found, but it is scarcely possible to suppose that none of the Anglo-French subjects and of the Huguenot refugees were artists) towards the middle of Elizabeth's reign tended to the degradation of the style; and in the reign of her successor it was, by similar means, so far altered as to have since had the epithet of Jacobean applied to it. The date of the erection of the banqueting house at Whitehall, 1619, is about the earliest period at which the purer style, or grander manner, was fully exhibited in this country.

Publications upon architecture having been rare in England at the commencement of the epoch under consideration, it is desirable to present a list of those that were issued, as a means of examining one of the sources from which those artists who had not travelled, obtained their notions of the theory and details of the newly fashionable style. Some other particulars as to the surveyors and architects employed, not generally known, are added; while, arranged in a chronological order, in a third list, are the most noted buildings erected in England during the periods in question (nearly all are illustrated in the publications appended to this article). It is believed that these tables will place the introduction and development of the Elizabethan style in a new light, whilst they will point out more clearly than has hitherto been done the position, in the history of the art, of the best specimens, and the decadence into the

Jacobean style. Some other erections during these periods will be best noticed under HALF-TIMBERED HOUSE; TUDOR ARCHITECTURE; POINTED ARCHITECTURE.

ALBERTI (editio princeps), Florence, 1485; Paris, 1512; London, 1726; was followed by VITRUVIUS, editio princeps, fol., Rome, 1486, five other editions were succeeded by the (first) Italian translation by CESARE CESARIANO, Como, 1521: COLONNA, *Poliphili Hypnerotomachia*, Venice, 1499, the date of 1467 is spurious; Paris, 1546; London, by R. D., part only, 1592: LABACCO, Rome, 1522: RODLER, *Eyn schon nuetzlich Buechlein*, Siemern, 1531: SERLIO, Bologna, 1540, etc.; Antwerp, 1542; London, by PEAKE, 1611; and the three authors, Alberti, Vitruvius, and Serlio, are alone mentioned by HARRISON, writing in 1577: VAN AELST, Antwerp, 1545 (part of Serlio); BORDE, *A Dyectorie*, etc., London, 1547: MARTIN, Paris, 1547: BLOOMER, BLUOM, or BLOEM, Zurich, 1550; London, by J. T., 1635: SALVIATI, Venice, 1552: CATANEO, Venice, 1554: (*Elizabeth's accession*, 1558): ANDROUET DU CERCEAU, *De Arch.*, Paris, 1559; *Des plus Excell.*, 1576; *Petit Traitté*, 1583; *Livre d'Arch.*, 1615: FRISIUS or VRIESE (repub. by HONDIUS), *Persp.*, Leyden, 1559; *Fountains*, 1568; *Arch.*, Antwerp, 1577: COUSIN, *Perspective*, Paris, 1560: BULLANT, Ecouen, 1563, and Paris, 1564; *Geometrie*, 1567: BAROZZI DA VIGNOLA (Siena?), 1563; Antwerp, by CAXES, 1593: SHUTE, *First and Chief Grounds*, etc., London, 1563 and 1584: CAMMERMAYER or CAMMERMEIR, Nuremberg, 1564: DE L'ORME, *Nouvelles inventions*, Paris, 1561; *Le premier tome*, Paris, 1568: PALLADIO, Venice, 1570; Paris, 1642; London, 1st book by RICHARDS, 1663; London, by LEONI, 1715: RIVIVS, Basle, 1582: LOMAZZO, Milan, 1585; Oxford, by HAYDOCKE, 1598: DIETTERLEIN (*Grotesque Ornaments*, etc.), Nuremberg, 1594 and 1598: BACON, *Essays*, London, 1598 (*On Building*): MAUCIER, *Le premier livre*, Rochelle, 1600; *Traité*, Paris, 1648; London, by PRICKE, 1669: EVELMAN, Cologne, 1600 (*James I. succeeded* 1603): SCAMOZZI, Venice, 1615; BURGER (*Grotesque Arch. and Ornts.*), Nuremberg, 1615: HONDIUS, *Instructions sur les cinq rangs de l'Arch.*, Amsterdam, 1617: FRANCINE, Paris, 1621: etc.

Besides the surveyors and architects to be mentioned with the buildings, the following list will record some others already known, with a few lately recovered.

Whilst Holbein was occasionally employed, James Nedam, 'the king's carpenter', afterwards held the office of surveyor-general of the king's works from 1537, the earliest date ascertained, to 1546, the latest. Lawrence Bradshaw succeeded him, and was living 1571. The grant by Henry VIII to John of Padua, 'pro servitio in architectura et musica,' is dated 1544; and was renewed by Edward VI, 1549: Richard Woodward was 'clerk of Windsor Castle', and Roger Amice or Ams, the king's surveyor, 1555-8. In 1561-2, . . . Revell was surveyor of the queen's works; 1582 Thomas Graves held the appointment; 1595 Robert Adams died in the same office; about 1605 Sir David Coningham was surveyor to the king; 1608 Simon Basyll was appointed to the office; in 1610 Inigo Jones was surveyor, and Francis Carter was clerk of the works, to prince Henry, after whose death, 1612, Carter became clerk of the works to the king, and Jones was appointed surveyor of the king's works 1615; he died 1652, when Carter succeeded as state surveyor to the Commonwealth. Among other names of less importance are recorded Sir Richard Lea; — Stickles; Bernard Adams; Stephen Harrison; and John Shute: many of whom with their works will be recorded in the biographical articles; and later in this notice will be found the remarkable passage in which HARRISON seems to intimate that amateurs exercised a considerable influence over design.

The buildings, still existing, erected during the commencement, flourish, and decadence of the style, here follow, wherever exhibiting the features of Italian art.

A palace now the palazzo Giraud in the Borgo Nuovo at Rome, it will be remembered, was erected 1612, by Bramante, for the

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cardinal Adriano de Corneto, who when compelled to leave Rome in 1517, presented the palace to the crown of England; at the Reformation it was inhabited by the ambassadors of Henry VIII; and views or models of this building may have been sent to England. The tomb of Henry VII (who died 1509) in Westminster abbey church, was executed in about three years, with the assistance of English workmen, under an agreement signed in 1516, by Pietro Torregiano, an Italian sculptor, who may have come to England as early as 1506; he is also supposed to have executed that of Margaret, countess of Richmond, in the same building, and of the same period. In 1526 Hans Holbein arrived from Basle, and was introduced to the king in 1529. In 1526 the stained glass with Italian ornament, in King's College chapel, Cambridge, was contracted for; the organ screen dates 1534. The queen's closet in S. George's chapel, Windsor, had been executed before 1529, the year in which queen Katherine of Arragon was divorced, her arms being introduced. Girolamo da Trevigi, employed as an engineer by the king, and killed at the siege of Boulogne in 1544, is said to have introduced molded work or terra cotta, of which Sutton-place, Surrey, 1530, exhibits a good example; the gateway at Whitehall, by Holbein, will be remembered as another. The roof of the great hall at Hampton Court palace dates 1531; bishop West's chapel in Ely cathedral was "very sumptuously built by himself," 1515-33, the vaulting has Italian enrichments (*Illustrations*, s. v. CEILING, 1857-8); the monument in Canterbury cathedral to archbishop William Wareham, 1532 or shortly afterward; and Benthall house, Shropshire, 1535; (the Louvre in Paris was commenced by Lescot, 1540). The ceiling by Holbein of the chapel royal, S. James's, is dated 1540; and between 1540-53 was executed Wilton, Wiltshire, also by him, portions of which and the gatehouse now removed into the garden, exist. Weston hall, Warwickshire, 1545, still shows a dining room (its owner obtained workmen from Flanders to make tapestry at the neighbouring village of Barcheston); Somerset-place, London, erected in 1546-9, in a purer style, is attributed to John of Padua; the celebrated Nonsuch palace, Surrey, was commenced by Henry VIII, who died in 1547; the fortifications of this period have nearly all been destroyed. Edward VI died in 1553. In Mary's reign, who died 1558, a gatehouse at Tixal, Staffordshire, exhibiting three orders of architecture, has the name of William Yates upon it; in 1555-8 the "almes knights' lodgings" at Windsor, had Roger Amice for their surveyor.

In Elizabeth's reign, one of the earliest, and also a well developed example of the style called from her name, was that of Buckhurst, Sussex, cir. 1560, by Lord Buchurst (as he signed his name), given among John Thorpe's drawings, but no longer existing. After this may be named as places for study, Loseley manor house, Surrey (Gothic with Italian forms creeping in), 1562-8; Middle Temple hall, London, 1562-72; parts of Trinity college, Cambridge, cir. 1564, by R. Simons; the priory at Warwick, 1564-6; (the first royal exchange, London, 1566-7, by Flemish workmen); the exterior of Longleat, Wiltshire, 1567-80, by John of Padua or John Thorpe, a pure example; the court and gateways to Caius college, Cambridge, 1567-74, by Theodore Havens or Heave of Cleves; Kirby, Northamptonshire (GWILT; *Encyc.*, says Bethnal Green, where there was a building of the time, called Kirby castle), 1570-2, of which John Thorpe laid the first stone; part of Penshurst, Kent, 1570-85; Knowle, Kent, 1570 and 1605; part of Kenilworth castle, 1571-5; (Eastbury, Essex, cir. 1572, is Tudor;) Boughton Malherbe, Kent, 1573; the gallery at Windsor Castle, now forming part of the library, "a perfect and highly ornamented specimen of the Anglo-Italian architecture" (PONTER), 1576, by Henry Hawthorne (?), the surveyor there; the terrace having been formed, 1572-5, by Henry Michell, then clerk of the works; Burleigh, Northamptonshire, 1577-87, by John Thorpe (?), a pure example; Rowell or Rothwell market house, 1577, and

Liveden house, 1577, both in Northamptonshire, both by Sir T. Tresham, and of good detail; Wollaton, Nottinghamshire, 1580-8, by John Thorpe (?), continued by R. and H. Smithson, a pure example; Montacute house, Somersetshire, 1580-1600; the south front of Corsham house, Wiltshire, 1583; Castle Ashby, Northamptonshire, 1583-9-1605; Emanuel college, Cambridge, 1584, by R. Simons; Brereton hall, Cheshire, 1585-6, of which the queen laid the first stone; the courtyard of Kelston or Kelweston, Somersetshire, cir. 1587, the house is said to have been erected after a model by Vignola; Lulworth castle, Dorsetshire, 1588-1609; parts of Haddon hall, Derbyshire, 1589; Westwood, Worcester, 1590; the ruins of Hardwick hall, Derbyshire, 1590-7; Longford castle, Wiltshire, 1591-1612, by J. Thorpe (?); Bramhall hall, Cheshire, 1592; the door and parts of Cobham hall, Kent, 1594; Rushton hall, Northamptonshire, and its curious triangular lodge, 1595-1630, by Sir Thos. Tresham, the owner; three existing rooms of a house at Great Yarmouth, Norfolk, 1596; Dorton house, Buckinghamshire, 1596, a pure example; (Whitgift's hospital at Croydon, Surrey (Tudor), 1596-1602); Sidney Sussex college, Cambridge, 1596-8, by R. Simons; and the remains of Canonbury house, Islington, 1599, the richest specimen to be found in London. Among the fortifications, part of Upnor castle, Kent, 1559-60, and Elizabeth castle, Jersey, 1586, should be mentioned. Queen Elizabeth died in 1603.

The Duke's, or Kingston, house, Bradford, cir. 1600, a fine example; Northumberland house, London, 1605, by B. Jansen, the façade by G. Chrismas (?); Holland house, Kensington, 1606-7, by J. Thorpe (?); Bramshill, Hampshire, 1607-12; Charlton house or Great Charlton, Kent, 1607-12 (both said to have been built for prince Henry); Hatfield house, Hertfordshire, 1608-11; (the picture gallery at Richmond palace, Surrey, 1610-12, was by Sol. de Caus); Ford house, Devonshire, 1610; Audley End, Essex, 1610-16, by B. Jansen, and additions by J. Thorpe (?), the model said to have been procured from Italy; Ham house, Surrey, 1610; Bolsover, Derbyshire, 1613, by H. Smithson; the public schools, Oxford (the gate of five orders, etc.), 1613-19, by Thos. Holte; Crewe hall, Cheshire, 1615-36; the remains of Houghton house, Bedfordshire, 1615-21, in which Inigo Jones introduced porticoes from Palladio's work; Dorfold house, Cheshire, 1616; Aston hall, Warwickshire, 1618-35; Blickling hall, Norfolk, 1619-20; Abbot's hospital, Guildford, Surrey, 1619-21; Wothorp house, Northamptonshire, shortly before 1622, a singular example; Boston house, Brentford, 1623; Sir Paul Pindar's house, Bishopsgate-street Without, London, cir. 1625; and Sherborne house, Gloucestershire, cir. 1600-50: (the banqueting house, Whitehall, was commenced June 1, 1619). James I. died in 1625.

A few later examples of the styles in question, will complete the list: Claverton, near Bath, Somersetshire, 1628 (destroyed); the second quadrangle of S. John's college, Oxford, 1631-5, attributed to I. Jones (?); town hall, Leominster, Warwickshire, 1633, of timber, by John Abel; Summer hill, Kent, before 1636; and the first portion of Clare hall, Cambridge, 1635-8, a peculiar example. The other works by Inigo Jones need not here be mentioned. Among the contemporary works in Scotland are Craigievar castle in the Highlands, cir. 1611; Wintoun house, near Tranent, 1620; while in Edinburgh are, Moray house, cir. 1628; Heriot's hospital, 1628-49; and the hall of the old parliament house, 1632-40.

The tombs especially exhibit many of the peculiarities of the ornamental portions of this style. GWILT, *Encyc.*, observes that "the pride and magnificence of the aristocracy were as equally displayed in the sumptuous monuments erected to the memory of the departed, as in their stately palaces; and we can scarcely point to a county in England whose parish churches do not attest the fact by the gorgeous tombs that exist in villages where the mansions of those thus commemorated have not long since passed away from the memory of

man. A year's rental of an estate, and that frequently under testamentary direction, was often squandered in the sepulchral monument of the deceased lord of a manor." A few early tombs have been already mentioned: that to bishop Gardiner, 1555, in Winchester cathedral, has Ionic columns; the altar tomb to Sir Anthony Browne, ob. 1548, in Battle abbey church, is noticeable for its early date and fine work; a good one, dating 1561, in Borley church, Essex, to the memory of a Waldegrave, is 9 ft. long, 5 ft. wide, and 14 ft. high, with Corinthian columns: among the best examples, GWILT mentions that of Thomas Ratcliffe, earl of Sussex, at Boreham, ob. 1583; that of his countess in Westminster abbey church, ob. 1589; of Robert Dudley, earl of Leicester, at Warwick, ob. 1588; and of Henry Carey, lord Hunsdon, in Westminster abbey church, ob. 1596: the tomb of bishop James Montague in Bath abbey church, ob. 1618, is without a canopy; that of archbishop Goldsborough, in Gloucester cathedral, dates 1604; and that of Thomas Sutton, in the chapel of the Charterhouse, was finished 1614, costing £366:15:0; whilst perhaps one of the largest and most characteristic, is that to Elizabeth herself in Westminster abbey church. The chancel of Swinbrook church, Oxford, affords all variations in the mural memorials which, recording the deaths of members of the Petiplace family, range from about 1562 to 1686. Many of the tombs above named are more Jacobean in character than Elizabethan, and were evidently designed under the influence of Flemish sculptors, so many of whom were practising as statuary carvers during that period.

Half-timbered houses were the erections naturally consequent upon the vicinity of the necessary forests; this Elizabethan style, however, is well adapted for the contrasted combination of stone with brick, especially if the latter be red in colour; the brickwork being often variegated, as in the Tudor period, by the intermixture of darker bricks, so disposed as to form in the walls patterns more or less regular, generally consisting of intersecting diagonal lines. When brick alone has been employed, the ornamental members are often formed of molded bricks, but the whole presents rather a sombre appearance. Holland house; Charlton house, Kent; Oxnead house; East Basham; Westwood house, near Droithwich; Ham house, Surrey; Dorfold house (1616); Crewe hall (1615-36); and Aston hall (1618-35), are all good examples of brickwork; and the three last named are presumed by RICHARDSON to "have been erected by the same architect; many of the ceilings, fireplaces, staircases, etc., being nearly the same in all three houses. The early rudeness of the style is seen at the first, its purity at the second, and the commencement of its deterioration in the third": the dates, however, would appear somewhat to deny the latter conclusion, though the former part might be correct. The same author, in the *BUILDER Journal*, 1846, iv, 319-20, urges that in the Elizabethan style, the separate works of the Italian, the German, and the English artist, can easily be detected. Their works have each strongly marked characteristics. In the Italian, the details are pure, the proportions correct, and the ornaments better designed and executed. A good specimen will be seen in the screen in the great hall of the Charterhouse (1560-75). The fireplace in the same room is by a Dutchman, in this style; the ornaments are vulgar, the proportions heavy, and the moldings few and clumsy. The entrance to the Temple, opposite Chancery-lane (1611?), belongs to this class. The work of the English artist exhibits not quite the elegance of the Italian, nor the rudeness or strongly developed forms of the German, though it gives evidence that both foreign styles have been diligently studied, as at Crewe hall (1615-36).—It is to the Germans and the Dutch that the enrichments peculiar to the Elizabethan style may be referred.—It is a mistake in supposing that Elizabethan architecture is a mere medley of Gothic and Roman forms; when the style was fully formed no Gothic details existed in it. Some few forms of the old Gothic house were retained, as the oriel, and the bay window was too especial a feature to be discarded, this rendered it

necessary to use the mullioned and transomed window. In the same spirit HAKEWILL concludes the prefatory remarks to his work, by stating that "the theory which these observations would establish is, that the pure Elizabethan is the cinquecento of Italy, unmixed with Gothic forms or Gothic enrichments."

Whilst the style was mainly in use for domestic or at least secular purposes, it must not be forgotten that down to so late as the middle of the seventeenth century, mediæval architecture was continued in use for churches and chapels. "The chapels attached to the domestic buildings of these reigns, furnish a sort of converse to the porches. They were generally in the Gothic style, although the buildings to which they were attached might be Italianized;—of the low character of Gothic which then prevailed, but unmixed,—at Crewe hall the chapel, which occupies the centre of the north front, is Gothic (however debased), and forms a curious spot in the middle of the Italian façade": RICHARDSON, *Studies*. Copenhall church, Cheshire; and Little Gedding church, Northamptonshire, *temp.* James I, restored 1854, exhibit complete specimens; a screen and some pewing, 1612, in Yarnton church, Oxfordshire; three windows, with the north wall of the nave (now the chancel) of Wymondham church, Norfolk: Sunningwell church, near Oxford, has a singular polygonal west porch, having a mixture of Italian and Gothic; with some good woodwork of the same period in the church, which had been chiefly rebuilt 1560-71: richly carved pulpit and stalls, "of Flemish workmanship and singularly curious", are in the church of Cockayne Hatley, Bedfordshire; a pulpit, 1637, in North Cray church, Kent; the fleur de lis terminations to the bench ends of the stalls of Salisbury cathedral are of the time of Henry VII or VIII, and an evidence of the newly introduced Italian form of ornamentation; as are parts of the Martin pew in the south aisle of Long Melford church, Suffolk: a font cover, *temp.* Charles II or later, is to be seen in Attleborough church, Norfolk. S. Catherine Cree church, Leadenhall-street, London, rebuilt 1628-30, affords a curious illustration of the late Gothic, and perhaps the first attempt at vaulting in plaster work.

The long and ample galleries, often of very low proportion as to height, which although frequently placed on the upper floor were intended for exercise, for libraries, and for pictures; the state rooms with 'delicate and rich cabinets, daintily paved, richly hanged, glazed with crystalline glass; and all other elegance that may be thought upon', which BACON, *Essay on Building*, demanded from the architects of that period, show clearly enough that these grand rooms, in addition to the hall of Tudor times, and many chambers, small in fact, but much larger and more numerous than the closets of the mediæval dwellings, were the requirements of the day for mansions. At the same time that the plan of the mediæval residence was fitted to receive these results of alterations of manners and customs, it had, especially towards the end of Elizabeth's reign, to find room for the staircases, which became spacious and splendid examples of skill. These were decorated with carved balusters and newels, the latter having panels of foliage, frets, and devices, and frequently surmounted with heraldic supporters. Porches and arcades were generally and elaborately decorated with the orders, caryatides, and other enrichments (in the later buildings these exhibit all the characteristics of the Flemish school); which were also displayed in the parapets and balustrades of the exterior. The ceilings are as diversified as any other portion of the detail: the main divisions were sometimes formed by the girders of the floor above, the spaces between being divided by ribs; or were molded and carved; or the ceiling had pendants richly carved; or had rich plaster enrichments, heavy cornices filled with festoons, shields, etc. The great open roofs of the mediæval period were emulated in some of the larger halls; and in these, screens shutting off the passage of entry or the communication with the offices, exhibited the orders and caryatides, with

panelled work and niches, festoons, and other decorations in great profusion. The chimneypiece was a very favourite part of the house on which to display all these peculiarities of the style, and to lavish the wealth of the owner; that of the Star Chamber (dated perhaps erroneously 1500), removed to Leasowe castle, Cheshire, in 1836, seems to deserve particular notice. Tapestry was used, but less than in the previous style. Wainscoting took its place either for the whole height of the room, or as a high dado, the portion above it being plastered, coloured, and covered with proverbs and sentences. Richly painted glass was continued. The windows, square-headed and without tracery, retain much of the Perpendicular character, being divided by mullions and transoms, into any number of lights; this sort of design admitted any width for a window, so that as one opening was frequently put very close to another, a façade might consist of little else than windows of various plans separated by piers that were no wider than was actually necessary to support the main timbers and chimneys. In consequence, when columns were employed merely as decoration for the distinct stories (and perhaps no Elizabethan designer thought of embracing two stories in the height of one order), or for the separate compartments of a front, the space between the pillars lost all character of the classic intercolumniation. The orders of Italian architecture were employed chiefly as decoration confined to the height of the story in which they were applied; and their pillars were further reduced in size by being placed on pedestals. The orders were assimilated in character except as to such distinctive marks as capitals and triglyphs: thus the Doric was frequently as slender and as decorated as the Corinthian. The shafts of columns and pilasters were rarely plain; the lower third was frequently carved, whether the rest were plain, fluted, carved, or broken by one or more plain, faceted, or sculptured bands. The entablatures were covered with carved moldings; and generally returned on each column or other salient feature. The pedestals were usually panelled in a variety of patterns, and enriched with carving. In fact, in England as elsewhere, the use of wood forced the sculptors to adopt a smallness of scale, which was essential for internal work; and afterwards they were not afraid to exhibit externally, without any alteration of size, a repetition of the decorative features which they had employed internally.

The quaint ornaments of the parapets to houses and roofs, and the window coronets (*Illustrations*, 1850-1, s. v.) and the gabled crests would require a large number of illustrations to exhibit the wondrously varied combinations which were devised. HARRISON, 1577, relates that "it is a worlde to see how divers men being bent to buildinge, and having a delectable view in spending of their goodes by that trade, doo daile imagine new devises of their owne to guide their workmen withall, and those more curious and excellent than the former", etc.: armorial bearings, fruits, flowers, and foliage, almost all objects of animal and still life, were adopted as means of decoration, as well as the details used by the Italian masters but developed under other forms: globes or balls of stone or wood, especially when surmounted with obelisks, were much employed for finials to newels, gables, etc. Differently shaped gables, small cupolas of varied forms on turrets, and rich chimney shafts, mingled (when seen in perspective) in apparent confusion, often give an air of magnificence to structures that would otherwise be poor and homely: and, aided by the quaint parapets, the porches sometimes carried above the topmost story, the projecting windows, and other picturesque breaks, give a variety to the skyline, an effect of vivacity to the building, which often cannot be well obtained by any other means. This effect was frequently aided by the system of wall decoration; in Italy a plain surface of wall externally may look well, but under an English sky some system of ornament is needed to excite an interest which may be greatly heightened by the presence, though not destroyed by the absence, of direct light.

"The most important and interesting features of the gardens were the terraces, imitated from the Italian, and (where the ground favoured the design) ranged successively one above another, and connected by flights of stone steps and balustrades. These were adorned with vases and statues, and displayed both taste and grandeur in their forms: those of Haddon hall—of Claverton—of the Duke's house at Bradford—and of Holland house—are universally admired for their elegance and good effect. Heslington hall, Yorkshire, cir. 1582-1605, a characteristic example of the period of Elizabeth, still retains its gardens. The rest of the designs for gardens belonging to mansions of this description included parterres, bowers and perspectives,—fountains, canals, and fish-ponds. A bowling green formed an essential part of the plan, and not unfrequently a wilderness and labyrinth were included in it"; RICHARDSON, *Observations*, 11. One of the very few remaining gardens of James I's reign to be seen in England is that of Campden house, Kensington, built about 1612. A bridge over the moat at Blickling hall, Norfolk, 1620, is 33 ft. long and 10 ft. wide. Another at Kenilworth castle is of the date 1571-5.

Terms can hardly be found strong enough to reprobate the present practice of copying the imperfections of this style, which seem to be cherished in proportion to their extent of eccentric deviation from the usual routine. Although the faults of its later examples must always cause it to take a low rank in art, the student may find in a study of the earlier examples opportunities of weeding out many of the impurities, and of taking its good qualities as a starting point from which to work out a domestic style, suitable to our present wants, and possessed of a real artistic value. Regarded merely as a phase of art, however debased may be the detail and ornamental features, this style would deserve more careful consideration at the hands of the historian than has ever yet been awarded to it, notwithstanding the many publications having reference to its elucidation and illustration. There is no work which can be said to give a satisfactory history or practical synopsis or analysis of it; the following publications consist chiefly of pictorial views, and the more architectural works are only miscellaneous collections of parts or details without any arrangement whatsoever. The best notices on the style itself are perhaps those prefixed to RICHARDSON, *Observations*, etc.; a short account by him in the *BUILDER Journal*, 1846, iv, 319; and the article in the *PENNY CYCLOPÆDIA*, supp. s.v., all which have been made available in the latter part of this article.

THORPE, *MS. Volume of Plans*, etc., in Sir John Soane's Museum, fol.; SHAW, *Details of Eliz. Arch.*, 4to., 1839; CLARKE, *Domestic Arch. of the reigns of Eliz. and James*, 8vo., 1833; CLARKE, *Eastbury Illustrated* (Tudor), 4to., 1834; LAMB and LERDS, *Studies of Ancient English Dom. Arch. of the times of Henry VIII, Eliz., and James I*, fol., 1846; HAKEWILL, *Attempt to Determine the Exact Character of Eliz. Arch.*, 8vo., 1835; RICHARDSON, *Observations on the Arch. of England during the reigns of Eliz. and James I*, 60 pl., 4to., 1837; RICHARDSON, *Arch. Remains of Eliz. and James I*, fol., 1840; RICHARDSON, *Studies from Old English Mansions*, fol., 1841-8; CLAYTON, *Ancient Timbered Edifices of England*, fol., 1846; ROBINSON, *Vitruvius Britannicus* (including Hatfield house, Hardwicke hall, and Castle Ashby), fol., 1827-41.

HALI, *Baronial Halls*, etc., 4to., 1843-8; BILLINGS, *Baronial Antiq.*, etc., of Scotland, 4to., 1848-52; NASH, *Mansions of England*, four ser., fol., 1839-49; NEALE, *Seats, Mansions, etc., of Great Britain*, 12 vols., 4to., 1822-32; BRITTON, *Arch. Antiq.*, 4to., ii, 1807-14; KIP and KNYFF, *Britannia Illustrata*, 4 vols., fol., 1708; 312 pl., 1715; 1720-40; the early volumes of the *BUILDER Journal*, passim; also for furniture and paper, viii, 15. The county histories, as ORMEROD's *Cheshire*; SKELTON's *Oxfordshire*; BAKER's *Northamptonshire*; NICHOLS' *Leicestershire*; and others: HARRISON, in HOLLINSHED, *Chronicles*, "Of the manner of building and furniture of our houses",

i, book 2, c. 12, edit. fol., London, 1585 (c. x, 1st edit., 1577); LANEHAM, *Letter describing the Pageants at Kenilworth*, 1575, new edit., 8vo., 1821. A long list in alphabetical order of houses of the Tudor, Elizabethan, and Jacobean periods, is given in HOWITT, *Rural Life*, 8vo., London, 1838, i, 391.

EL-JEM (Fr. *El-djem*) or EL-JEMM in Tunis. A modern name of THYSDRUM.

EL-KAB in Egypt. The modern name of ELEUTHYIAS.

EL-KHARGEH in Egypt, see HEB.

ELL. A measure of length, namely 45 ins. or five quarters of a yard, sometimes used in old descriptions of buildings, though it chiefly referred to cloth, etc. The Flemish and French ells are stated in the *PENNY CYCLOPÆDIA*, s.v., to have been respectively 27 and 54 ins. long, but the authority for these dimensions does not appear; indeed the French *aune* seems to have been a fifth more than the *mètre*, i. e. 3.937 English feet, according to the Parisian ordinance of 1554, while CRESY, *Encyc.*, 1847, makes it 3.90786; he also gives the Scotch ell as equal to 37.2 English inches.

ELLAHNEEL. A small tree of Travancore, East Indies. The wood is of a light red colour, and is used for temples, pagodas, and furniture.

ELLAND EDGE. The stone quarries which pass under this name are situate about four miles from Halifax in Yorkshire; are considerable in number; of varied size; and from 30 to 60 ft. in depth. The stone which they yield is of the millstone grit formation, and their supply is limited exclusively to landings, steps, flag-stones, etc. It is "composed of moderately fine quartz grains with an argillo-siliceous cement that is micaceous in the planes of the bed; of a light grey-brown in colour, and weighs 153 lbs. 4 oz. per cubic foot": *Report on Building Stones for New Houses of Parliament*. The best and most durable stone is acknowledged to come from the quarries of Fixby Park. In the neighbouring quarries of Southowram, situate about two miles from Halifax, the stone is almost identical in quality and texture with that of Elland Edge, but it is somewhat paler in colour: they have, too, been opened more recently; and if any fear exists of the best beds of a stone, which would seem almost uniformly good, being less abundant, that fear must apply to Elland Edge. The quarries of Southowram now largely supply the market. This stone is homogeneous in texture and colour, except that occasionally pieces of iron ore are visible of varied size, from the dimensions of a pea to an inch or two in diameter—emphatically distinct from the stone itself—which have the effect of 'turning' the edge of any tool which comes in contact with them. Unlike stones, which in general are distinguished by greater density and specific gravity in the lower beds of the quarry, the stone from all positions of the Elland Edge quarries has no perceptible difference in its density or specific gravity. The argillo-siliceous cement which unites its molecules can be distinctly seen as the stone lies upon its bed in the quarry, wherever there may happen to be any vertical fissures, coursing down its face like semi-molten ice; this circumstance would seem to argue ill for its durability if it were a 'block' stone, and exposed to atmospheric changes; but really not so considering the purposes to which it is applied. This peculiarity of a liquid streaming down the face of the stone is only observable in these natural fissures, and is a rare occurrence in stones which are newly cut.

The superficial area of landings of the usual thickness which may be quarried seems incredible; thus landings of a superficial area of 900 ft. might be obtained, if they could be used for any practicable purpose. The thickest beds which can be raised lie at the bottom of the quarry, and perhaps nowhere exceed 10 ins.; and these graduate upwards, diminishing until at the top slates can be raised as thin as $\frac{3}{8}$ in., with two perfectly natural beds. Upon this upper bed, and overlaying the more durable stone, is a certain proportion of rag stone, which is not considered herein. All intermediate thicknesses may be obtained without having recourse to the wedge; and the various

thicknesses may be depended upon, and may be largely obtained possessing two 'mustard' faces almost as parallel and clean as if the stone had passed through the hands of the workman. This remark can scarcely apply to the thickest beds, which generally speaking are not quite parallel, but have the disposition to arrange themselves with a less thickness at one end than at the other. The thickest beds, and those lowest in position in the quarry, are for the most part cut for steps; the middle beds are raised for landings; while the uppermost beds are eminently suitable for flag paving and like purposes. When wedges have to be resorted to, and the stone by this means is to be separated between its laminæ, it is capable of being done in a clean manner. Although the stone is "micaceous in the planes of its bed", and that alone is a satisfactory guide to arrive at its relation to its original position in the quarry, yet the laminæ are always distinctly visible.

There are two objections to the use of this stone: 1, that whilst a fair price is asked and given for the stone, the amount of labour required to reduce it to shape and to work it clean is very great, as in the case of astragal steps with a raking soffit, which, when added to the expense of carriage, has put a check upon its free use, especially when a local stone or a stone in more immediate proximity might answer the purpose at a much less cost, if not quite so satisfactorily; 2, that, in virtue of its distinctly laminated texture, and extreme density and hardness, it is difficult to obtain a perfect arris in a diagonal direction to the laminæ, such as that of the pien joint in the step of a hanging stair; but the more extensive appropriation of this class of stone to plainer purposes renders these objections to it of little account.

This stone is perhaps the most esteemed and valued of all those of its kind which Yorkshire, so rich in this building material, can produce. Were it not for the quarries of Laister Dyke, Shipley, etc., which yield valuable stone of a similar kind, that is sold in the market under the generic name of 'Bradford' stone from the Elland Edge quarries would be in greater demand in those parts of Yorkshire where 'Bradford' stone is now used, and wherever first class work was being executed. Thousands of superficial yards of Elland Edge flag-stones are annually sent to the metropolis, where they are most extensively used for street flag paving; and thousands of cubic feet of landings are annually supplied to the Manchester and London markets. Numerous buildings of importance in contiguity to the quarries may be named where this material has been used, and where its extreme durability in resisting attrition, to which force it is necessarily almost exclusively subjected, may be seen. Like other stones difficult to work, it has been laid on one side, as often as it could be done with impunity, for a less durable and more easily workable material; and where the two materials have been placed by the side of each other, the contrast, after the lapse of years, is greatly to the advantage of the Elland Edge stone. In Huddersfield, the greater proportion of the landings and flag paving of the railway station, of the Lion arcade, and of the George hotel, may be adduced as fair specimens of its worth as a building material; whilst it has been the rule of architects to introduce it in the stairs and landings of the numerous new and important warehouses erected of late years in that town. The Southowram stone has been in greater demand for landings, steps, and flag paving, by the architects of Wakefield, where it has been used in the large West Riding house of correction; the new workhouse; the lunatic asylum; and other large buildings.

Besides the above, this stone is very often appropriated to chimneypieces, wall stones, and door jambs for inferior purposes. The good qualities of this very useful building material need only be pointed out to produce its general introduction in new erections.

A. W.

EL-LEGEM in Tunis. A modern name of THYSDRUM.

ELLERTON (HENRY), or DE ELRETON, or DE ALLERTON, is called by DALLAWAY, *Discourses*, 8vo., London, 1833, p.

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421, magister operum in 1292 at Caernarvon castle (begun in 1284 and finished about 1322), but the authority is not given. The *Journal of the ARCHEOLOGICAL INSTITUTE*, 8vo., London, 1850, vii, 250, notices that there is preserved, at the chapter house, Westminster, an account roll for works at the castle of Caernarvon from 10 October 1316 to 1 May 1317, 10 Edward II, in which it appears that there were about ten masons kept at work; Henry de Elreton standing at the head of the list, being dignified with the title of *magister*, and receiving thirteen shillings, while the others had from twenty-one to twenty-seven pence, for the week's labour. GROSE, *Antiq.*, 4to., London, 1776, iv, records that the Rolls of Parliament of 1303 contain petitions from Henry de Aynsham, mason, Walter de Hereford, master mason, and Henry de Allerton whose occupation or office is not named, soliciting payment of money due to them; and he adds that PENNANT, *Tour in Wales*, 4to., London, 1784, ii, 224, on the information of the Sebright and Gloddaeth MSS., states that Ellerton was appointed master mason of the castle; for which reason BRITTON, *Arch. Antiq.*, 4to., London, 1826, iv, 168-9, like PENNANT, supposes him to have been the architect.

ELLIOT (ARCHIBALD), born in the parish of Ancrum in Roxburghshire, was educated as a joiner. It is said that he was engaged as a draughtsman to a cabinet maker in London; and that afterwards whilst working at Douglas castle, a difference arising between the architect and the proprietor, Elliot took up and completed the work. He became contractor for the erection of Mona castle, Isle of Man, for the duke of Atholl, which work was probably the commencement of his long patronage by that nobleman. He designed, 1804-6, Loudoun castle, Ayrshire (castellated Gothic), for the countess of Loudoun and Moira, given in RICHARDSON, *Vit. Brit.*, fol., Lond., 1808, ii, pl. 51-6: in Edinburgh, 1815-9, the Regent's bridge, carried over Calton-street in continuation of Waterloo-place, and consisting of an arch 40 ft. wide, 55 ft. high, and 80 ft. deep, surmounted on each side by a small colonnade, and an open arch with Corinthian columns in the centre; 1815-7, the new prisons (castellated Gothic) on Calton-hill; 1816-8, S. Paul's episcopal chapel (Perpendicular), built at a cost of £12,000; the internal dimensions are 105 ft. long and 63 ft. wide (a nave and aisles only); the nave, 26 ft. wide, is 46 ft. high, with a plaster vault after the form of King's college chapel, Cambridge; and 1816-9, the county hall, the portico of which is after that of the Erechtheum at Athens. NEALE, *Seats*, etc., 4to., London, 1823, gives in the 1st series, vi, Lindertis, Forfarshire (Tudor), as lately (before 1819) designed by Elliot for Gilbert Laing Meason, esq.; Taymouth castle, Perthshire (castellated Gothic), before 1810, for, and since greatly altered and improved by, John Campbell earl Breadalbane; and The Haining, Selkirkshire (Grecian Ionic), enlarged and improved by him for John Pringle, esq., of Clifton. Amongst other buildings may be named Jedburgh castle (the prisons, castellated Gothic); Newbyth (Gothic), for Sir David Baird; additions and restorations at Minto house; and, lodges with an extensive range of stabling at Dunkeld (castellated Gothic), for the duke of Atholl. He died at his residence, Calton-hill, 16 June 1823, aged 62 years, and was interred in the Calton new burying ground. His son ARCHIBALD designed the military academy, Lothian-road, Edinburgh, 1829-30; works at the gaols and county buildings; additions for the royal bank, in Edinburgh and in Glasgow; and died shortly after 1830 in London, where his brother was resident as a builder.

ELLIPSE, formerly written ellipsis (Gr. ἑλλειψις, a 'deficiency'; It. *ellisse*, *ellisi*; Sp. *clipse*, *clipsi*; Fr. *ellipse*; Ger. *ablangrundung*, *ellipse*). A section made, at any points between the base and the summit of a cone, by a plane passing obliquely through the axis of the solid.

The law that the angle of reflection equals the angle of incidence obtains in the ellipse as elsewhere; and in such manner that all rays proceeding from one focus, being reflected, are

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directed to the other. Thus, if sound proceed from one focus, it will be transmitted by reflection to the other focus, against whatever point, or however many points, in the curve it may impinge. The opposite pairs of recesses and covered seats formerly over the piers of old Westminster bridge may have been the opposite ends of long ellipses, in which conversations held in one were overheard in that over the way—when the traffic happened not to interfere. The concentration thus of rays in one point would appear in ordinary to be undesirable—audiences being usually numerous and widely spread; and the parabola, the rays from the focus of which are reflected in parallel instead of converging lines; or even a flatter curve, giving reflected rays which diverge, would seem to be more practically useful. At Cliefden house, near Maidenhead, there is in the basement story which is above ground, an elliptical music-room, surrounded with substantial walls excepting towards the garden, on which side (externally parallel with the major axis of the ellipse) there is a wide entrance. Here music performed by a band, especially if placed in either or both foci, would be reverberated from the elliptical surface, and, issuing in compact volume by the opening, be borne from the building, and thus be heard within it in a softened form. The room, however, is not used for musical purposes. I. W.

Except for amphitheatres the ancient architects do not seem to have approved the ellipse for a plan. Amongst modern architects it was perhaps first adopted for ecclesiastical buildings in Italy during the seventeenth century; after which period it occurs for rooms in some of the eccentric plans designed for domestic edifices. An elliptical plan for a church appears first to have been introduced in that of S. Giacomo degli Incurabili at Rome, either by F. Volterrano (ob. 1588?) or his successor Carlo Maderno: it was followed by Bernini in his great courtyard or peristyle (1655) in front of S. Peter's; as well as in his plan, and in his internal face of the cupola, of the church of S. Andrea Apostolo a Monte Cavallo or al Noviziato de' Gesuiti on the Quirinal. The church of S. Andrew, built 1781 at Edinburgh on an elliptic plan, is considered acoustically good; yet WHITEHEAD and WALSH, *History of Dublin*, 4to., London, 1818, i, 511 (describing the church of S. Andrew, built 1670 and rebuilt on the old foundations 1793, in that city, as an ellipse on plan 80 ft. long, 60 ft. wide, and 43 ft. high to the cornice), state that it is so unfavourable to the voice, that a preacher of ordinary lungs cannot be heard with any distinctness by a great proportion of the congregation. Perhaps the only example of a large room in London partaking of this plan is the church of S. Martin Outwich, Bishopsgate-street Within, erected 1796-8 by S. P. Cockerell.

With regard to the early use of the semi-ellipse for the vertical section of a dome, or for the figure of an arch, few examples will be adduced: HOSKIN, *Travels in Ethiopia*, 4to., London, 1835, p. 352, and LEPsius, *Denkmaeler*, fol., Berlin, 1849-59, pl. i, 89, ascribe the elliptic, or nearly elliptic, vault near the valley of the Queens at Thebes to the period of Amenoph I, i.e. at about 1550-35 B.C. A circular chamber, about 66 ft. 6 ins. in diameter, belonging to a ruin (misnamed the temple of Mercury, or of Hercules, also called il Truglio) at Baie, is said to have a circular dome with an elliptic vertical section. The elliptical section of the actual dome of the baptistery or church of Sta. Maria Maggiore, near Nocera dei Pagani, given by ISABELLE, *Les Edifices Circulaires*, fol., Paris, 1843, p. 87, dates according to that author in the time of Constantine. The celebrated edifices erected in Persia under the Sassanide dynasty, A.D. 226-632, will be noticed s.v. OVAL. The builders of Brambana (1188-1218) possessed the art of turning the elliptic arch and vault, although the circular arch and vault are nowhere to be found among the ruins, according to CRAWFORD, *History*, 8vo., Edinburgh, 1820, ii, 200. This form occurs in the arches of the crypt to the cathedral at Gloucester; and over a doorway to Castle Acre priory: the false ellipses of the ponte della Trinità, by Ammanato (1567-70), at Florence;

and of the dome to the Gol Goomuz (about 1630-60) at Beejapore, should be noted. The first use of the ellipse (or rather of a combination, in most cases, of a three or more centered curve) for a bridge, probably occurred in the case of the pont royal by Mansard (1684) at Paris. OBLIQUE or SKEW, ELLIPTIC ARCH.

It should be observed that the semi-ellipse, set upon its minor axis, for the vertical section of a dome with a circular plan, is considered the most graceful figure for such a purpose, although it may be doubtful whether in some of the following instances a parallel result has not been very nearly obtained by the mere truncation of a section that would otherwise be the representation of a pointed arch. Whether originated at Rome with padre Orazio Grassi in the church of S. Ignazio of the Jesuits, commenced 1626, or more probably with Carlo Maderno (1600-29) externally and internally at that of S. Andrea a Valle, the system was followed by Borromini, 1652, under the same conditions for that of Sta. Agnese. The dome of S. Paul's in London (1675-1710) is a striking example of its good effect. Borromini employed the ellipse for escutcheons, for windows, and the plans of altars, ceilings, and chapels; it occurs in the main arches (and perhaps in the whimsical plan) of the church of S. Carlo alle Quattro Fontane, built about 1639 at Rome, from his designs. LETAROUILLY, *Rome Moderne*, Paris, 1828-57, pl. 109, shows the situation of the refectory, elliptical on plan, and about 57 ft. long by 31 ft. wide, attached to the church of Sta. Maria in Vallicella (the 'Chiesa Nuova'); and pl. 183-5 fully illustrates the staircase upon a similar plan in the palazzo Barberini. The ellipse was externally and internally employed by Sir C. Wren in his London churches, as in the cupola elliptic on plan of S. Benet Fink (now destroyed), and for the plan of the ceiling of S. Antholins; he also used plastered vaults which were formed by a semi-ellipse on its major axis, as at Christchurch, Newgate-street; S. Andrew's, Holborn; and S. Mary-le-Bow.

ELLIPSOGRAPH or ELLIPTOGRAPH. The simplest way of describing an ellipse is to fasten one end of a hinged rule to the centre (of the proposed ellipse) marked on the indefinitely extended major axis, and to mark on the occupied leg the distance of half the minor axis, which will transfer to the other part of the hinged rule the length of half the major axis; or *vice versa* the rule may be opened and laid on the major axis, when (the extent in that direction being marked) it will similarly indicate, if closed, half the minor axis; the disengaged end of the rule being always kept to the major axis, half the ellipse may be described, and the rule has only to be laid on the opposite side of the axis to repeat the operation. But when the two foci are known, if two rods, each equal in length to the major axis, be fastened one to each focus, be allowed to cross each other, and are confined at the further extremities by another rod equal in length to the distance between the foci, then a tracing point at the intersection of the two rods will mark half the ellipse, while they are worked upon the foci.

Another method is to fasten into the paper a pin at each of the two points where the foci are to lie, and to let a thread equal in length to the proposed major axis have one end tied to each pin; then if a pencil move in such a way as to keep the thread always stretched, an ellipse will be the figure described by the marking point. These three operations, explained in BRADLEY, *Practical Geometry*, 8vo., London, 1834, are described because they facilitate the formation of every representation in perspective of a circle, that form being always the halves of two ellipses, although of late this has been denied. It should be remarked that, although an ellipse be an OVAL, an oval is not necessarily an ellipse. A figure may be formed, by arcs of circles, which may have the appearance, without possessing any property, of the ellipse: but especially when parallel elliptic curves are to be described, an ellipsis once truly drawn of a given size may serve to limit the search for four centres from which arcs may be struck that may be sufficiently coincident

with the true shape for all purposes of architectural or engineering delineation to a moderate scale. BRADLEY gives geometric methods of finding four or eight such centres. An ellipse of a size required may be afforded by the elliptograph with two gauges invented by Hick, and described in the *Transactions of the Society of Arts*, 1841, liv, 9: but it is more usually obtained by the use of the instrument formerly called elliptic compasses; this is the trammel still used by carpenters and other artificers, which consists of a board having in it two grooves, crossing each other at a right angle, and each holding a pin attached to one and the same beam or radial bar. It is known that if the two pins attached to the ruler be made to travel in the grooves, every other point in the ruler will describe an ellipse: the rapidity afforded by this instrument arises from the ease of making the distances from the tracing point to the two pins equal to the minor and major semiaxes of the required figure. As the defect of this trammel is that it will not very well give any ellipse less in size than the board in which the grooves are cut, nor any much larger than the board unless the semiaxes are nearly equal, several other modes of describing an ellipse have been produced; and each of them, like the elliptic compasses, has been called an ellipsograph or elliptograph, the former being perhaps the more correct, as well as the older, term. The trammel just described has become a complicated machine, perhaps most successfully on a large scale in the hands of Lowry, as described by BRADLEY, p. 305, and it seems to have considerable affinity with that produced by Hay, as reported in the *Civil Engineer Journal*, 1844, vii, 248, by which an ellipse from half an inch to eighteen inches in diameter may be traced. The instrument invented by Farey, and illustrated in the *Transactions of the Society of Arts*, 1813, xxxi, 117, is capable of dividing an ellipse into any number of parts. A more complete, but at the same time a more expensive, machine which can trace ellipses that differ only a thousandth part of an inch from each other, as invented by Clements, is described in the same *Transactions*, 1818, xxxvi, 133. 14.

The square of the minor axis subtracted from the square of the major axis gives the square of the distance between the foci; thus if the major axis be 5 ft. and the minor 4 ft., the distance between the foci will be 3 ft. J. T.

ELLIPTIC POINTED ARCH. An arch having its sides of the regular pointed form, but terminated with a flattened instead of an acute angle; BRITTON, *Dict. s. v.*, who justly adds that "it is not common."

ELLORA, ELORA, or ELOROT. A village near Dowlatabad in the province of Aurangabad in Hindostan. The ruins, enclosed by a stone wall, cover a considerable extent of ground. In the neighbourhood are the rock-cut cave-temples, which vie with, and in many respects surpass, those at Ajunta and Karli. Ellora presents one or more, and those among the best, examples of all the divisions under which FERGUSSON, *Illustrations of the Rock-cut Temples of India*, fol., London, 1845, has classified the subjects of his volume. In his first class of (vihara or monastery) caves, and the third subdivision (a hall having its ceiling supported by central pillars, a sanctuary opposite the entrance, and cells around the hall), which embraces by far the greatest number of Buddhist excavations, he finds the most splendid example at Ajunta, and adds that the Dherwarra, at Ellora, is also fine. The second (chaitya or church) class is represented by the Viswakarma cave. Of the third class (Brahmanical caves properly so called), which differs from the first in the arrangement of the pillars, the position of the sanctuary, the absence of cells, and the substitution of sculpture for painting, "the finest specimens are at Ellora and Elephanta." To the fourth class, consisting of rock-cut models of structural Brahmanical temples belong "the far famed Kylas" at Ellora. And FERGUSSON concludes his classification by remarking that the Indra Subha group at Ellora should perhaps form a fifth class, as it cannot in strictness be brought under any of the above heads; but it is difficult to decide

whether they are Brahmanical or Jaina: if the former, they belong to the third class; if the latter, they must be classed with what in reality form the fifth class, or true Jaina caves, which, without this splendid auxiliary, are few and insignificant, though there are some tolerable ones at Khandageri in Cuttack, and in the southern parts of India.

The same author observes that Ellora not only contains some of the most modern cave-temples of India, but has "the most complicated series I am acquainted with, containing examples of almost every kind, except, perhaps, the most ancient." He commences from the south extremity, where the Buddhist group exists, and consequently the most ancient caves of the series; and the gradation is then easily perceived by which they passed into the Brahmanical, which, after rising to its glory in the Kylas and Doomar Lena, again for a short time passed into the half-Jaina group of the Jugganath Subha, and ended there. The whole series at Ellora consists of about thirty excavations, of which ten are Buddhistical, fourteen Brahmanical, and six belong, properly speaking, to neither of these sects, yet they can scarcely be in strictness ascribed to the Jains, though savouring more of their religious tenets than of either Brahmanism or Buddhism.

The amphitheatre of rocky hill on which they are situated cannot be less than two or three miles measured on the chord; and the caves are scattered over a distance of about a mile and a half. Sir CHARLES MALET says, one mile from the Viswakarma or most southern group to the Indra Subha in a direct line; this great space, as FERGUSSON justly remarks, "takes very much away from the effect when viewed as a whole; and it is only when in the courts of the caves, or when studying their details, that you are aware of their greatness or magnificence. Viharas are never fine externally, and here less so than usual, owing to the sloping nature of the hill, which is also the cause that they can only be seen directly in front; and the Kylas is absolutely invisible from the exterior. Indeed a man might ride along the whole front, and at a few hundred yards distance, and, unless previously warned, never be aware that he was in their vicinity."

Of the Buddhist group the principal cave is the so-called Viswakarma (the only chaitya cave of the series), about 83 ft. long internally and 43 ft. wide, the exterior courtyard being a square of about 70 ft. with a colonnade on three sides. It differs from all others in having a triple instead of a single opening as a window in the front face of the cave. Internally two pillars support a gallery over the entrance, and are more decorated than the twenty-eight others which are simple octagons, changing in one part to sixteen sides. The panels of the 'triforium' belt are not praised by FERGUSSON, who mentions the corbel figures, alternately male and female, under the springing of each of the stone ribs of the ceiling. The date of this cave cannot, he thinks, under any circumstances, be placed higher than the sixth or seventh century of our era, and he would not bring it down lower than the eighth or ninth. "There are numerous viharas attached to this great cave, the principal of which is the great Dehrwarra, one of the largest excavations of the class that I know of, being about 110 ft. by 70 ft. including the side recesses: it is probably of the same date as the Viswakarma; if anything, more modern." Among these subsidiary works is a small vihara, in which the sanctuary stands free with a passage all round it; another having the roof supported by four pillars of the same detail as the Dookyaghur (the cave next it on the north); another, the outer half of which has fallen; another with twelve pillars on the same plan as those at Ajunta, though the detail is similar to the Viswakarma; another similar in plan, although the pillars are of the cushion form of Elephanta and the Dehrwarra; but the capitals are much better formed than in the last example and more ornamented," and it is probable that they were all executed within the same century as the Viswakarma.

The next three temples point out the successive steps by

which the Buddhistical caves merged into Brahmanism: the first is the Do Tal or Dookya Ghur, a purely Buddhist vihara of two stories, but apparently intended to have three; the next is the Teen Tal with sculptures deviating very far from the usual simplicity of Buddhism; while the third, the Dasavatar, separated from it by the Ravana Ka Kaie, hereafter to be mentioned, is another two-storied cave very similar in all its architecture and details to the two preceding, but having the sculptures all Brahmanical. This is considered the earliest temple at Ellora belonging to the last named form of worship; at least FERGUSSON draws this inference from the existence of a pseudo-structural mantapa, or shrine of Nundi, (for which the rock must have been originally left) in the courtyard.

The Brahmans then attempted something of the same class on a larger scale, and produced the Kylas, "the most splendid excavation in India," given in pl. 15 of FERGUSSON, who dates it in the first half of the ninth century. "Its whole interest cannot be appreciated without the contemporary examples from the north and south of India being placed in juxtaposition with it, so as to shew the difference of style from those around it, as well as its striking similarity with the great temples of the Carnatic. The gateway is exactly one of the gopuras which adorn all the temples of the south, and are unknown in the north; whether it had ever the pyramidal top with which all these are adorned, it is not very easy now to determine." The colonnade surrounding the area in which the temple stands is of course more modern than the temple itself; probably considerably so, as the style is different, and resembles more the northern style than anything in the temple itself, so much so indeed that it would almost seem as if the architects had reverted to the familiar types of the caves previously described, after the retirement of their southern friends."

The next six caves proceeding north, usually called the Rameswara, Neelcant, Teeli Ka Kanch, Kumarwarra, and the two Chendwassas, are all very much on the same (i.e. one) plan, and all at first sight singularly like small Buddhist viharas. The architecture "is of a northern type, and resembles, with some variation, details found in the caves to the south of the Kylas and at Ajunta, though differing in some respects to suit the two different religions to which they are dedicated. The Rameswara is the most complete, and its sculpture the best of any temple here, though much in the same style as those surrounding the Kylas. The most northern of the two Chendwassas is the only Vaishnava temple here, and at the same time the one that looks most like an appropriation. The sculpture, however, is so bad that the whole may belong to an age very much more modern than the others." FERGUSSON entertains no doubt that these caves are contemporary with two of those at Elephanta; "indeed there is a degree of similarity between the two series which is singular in structures so distant, which can only be accounted for by their being undertaken at the same time, and probably under the same direction."

The next to be described is the Doomar Lena, the finest and largest Brahmanical cave excavation at Ellora. The plan (pl. 4) of FERGUSSON resembles the chaõri, such as that to the great temple at Barolli; "the only difference between this and the structural chaõri is that here the temple or vimana is enclosed in the cave, while at Barolli and elsewhere the chaõri stands in front of the temple." There is here a singular resemblance to the great cave at Elephanta in every respect, both of size, plan, and detail; this, however, is the largest, being 150 ft. each way, while the other is only 130 ft. square; the pillars are so much alike that it requires drawings made on the spot to detect the difference between them. Two are given by him, pl. 9.

Notice need not be taken of several small caves, of little architectural importance, in the vicinity of this example; but the Ravana Ka Kaie, already mentioned as to its locality, is now to be considered with reference to its style and period. "It is a purely Brahmanical cave of a very florid style of archi-

ture. In form the pillars resemble a good deal those that surround the courtyard of the Viswakarma, though more ornamented, and it is here that first appears the vase and falling leaf, so common, afterwards, in the temples of Northern India."—"It may possibly belong to the position it holds locally in the series, and would be thus the earliest Brahmanical cave here, and the similarity of its pillars to those of the Viswakarma, rather favours this supposition; but its floridness, the style of sculpture, and the general disposition of the cave, incline me" (FERGUSSON) to place it much later, or, as here described, after the Doomar Lena. Another cave here taken out of its place according to locality "is called Lanka, and is situated above the colonnade in the northern scarp of the Kylas; from its position evidently executed subsequent to the great temple, and, from its design, I should think not less than one or two centuries later. Its details all belong to the northern styles, and are bold and good; indeed, as a specimen of cave architecture, I consider it the finest and best designed in the whole series. The pillars, which would be clumsy and inelegant in a structural building, are elegant and appropriate when viewed in conjunction with the mass of rock they support. The difference between this example and the Buddhist vihara, will be seen in the pillars standing all over the floor, at equidistant, or at least similar, distances from one another, not round a hall as in the others; in their being almost all dissimilar; and in the details being boldly sculptured, and not trusting to painting for their decoration, as at Ajunta, besides the other peculiarities mentioned in the text;" an interior view is given in his pl. 16.

"The next caves to be described are the Indra Subha group, consisting of four principal caves, and several smaller ones. In their architecture they differ very considerably from those already described, being generally more ornate, the pillars shorter and more massive, and a species of leaf falling over a vase being here introduced, which does not occur in any of the earlier examples; though something of the kind is seen as above mentioned in the Ravana Ka Kaie, and in the Lanka; indeed the style of the last named cave so completely resembles that of the Indra Subha, that I have no hesitation in placing them nearly in the same age, though it would be difficult to say which is the more modern."—"Be this as it may, I have little doubt that they are the last caves executed here, and I do not think their date can be carried higher than the eleventh or twelfth century of our era. There is one singularity in these caves that I am unable to explain, which is the form of the pseudo-structural temple in the courtyard in front of the Indra Subha. Like the Kylas, it seems to have come from the south, while the details all around it belong to the northern types; and though its age would by no means interfere with the date given above, its appearance here is singular, and its detail still more so."

It has been asserted more than once that these works are cut in a hard red granite; whereas, remarks FERGUSSON, "the rock is the usual trap formation of this side of India, a sort of porphyritic green stone or amygdaloid, I believe; but whatever it is, certainly as soft and as easily worked a material as could well be used for architectural purposes." The caves at Ellora are entirely deserted as places of worship, and their stucco and paintings have almost entirely disappeared, but their sculptures are not so easily broken, and are on too large a scale to tempt the cupidity of most collectors.

Ellora is described and illustrated by MALET, *Description*, in the Asiatic Society's *Recherches*, 4to., Calcutta, 1799, vi, 382-423, who refers to drawings about to be made by Wales, which were published in large size by DANIELL, *Antiquities*, fol., London, 1799, and smaller in the *Oriental Scenery as Hindoo Excavations*, 24 pl., fol., London, 1816; SYKES, *Account*, in the *Transactions of the Literary Society of Bombay*, 4to., Lond., 1823, iii, 265-323; SEELY, *Wonders of Elora*, 8vo., Lond., 1827, p. 106-332. The most intelligible view of the Kylas is given, with one of the Indra Subha, in GRINDLAY, *Scenery*, 4to., Lond., 1826; ELLIOTT, *Views in the East*, fol., Lond., 1833.

ELM, see CORDIA and ULMUS.

ELMES (HARVEY LONSDALE), born 10 February 1814 at Oving near Chichester, was the only son of James Elmes, once architect to the port of London, and author of various works. His natural bias being for architecture, he studied under his father, and his uncle H. J. Elmes; as also with John Elger, builder, for whom in after life he made many designs; among them were the houses and chambers built in the garden and stable-yard of a mansion in Hanover-square, the front of which was the handiwork of his great grandfather John Elmes; the façade of the terrace nearly opposite Albert-gate, Hyde Park; with other exteriors for Elger's speculations. He then for some time assisted H. E. Goodridge, architect, at Bath. In 1835 he became a student of the Royal Academy of Arts in London. In 1836-7 he entered into partnership with his father, assisting in the pile of buildings in Park-street, on the site of the old Cockpit, S. James's Park, and in the interior decorative finishings of several houses there for the residence of the Turkish minister.

In July 1839 he, out of eighty-six competitors, obtained the first premium of 250 (the second being 150) guineas, for S. George's hall, Liverpool; the plan embraced a main hall to accommodate 3,000 persons, and a concert room for 1,000, the cost to be £30,000. Being engaged to execute the design, he visited most of the domed works about London, and other similar buildings at Munich and other parts of Germany. In April 1840 he, out of seventy-five competitors, obtained the first premium of £300 (the second being £200) for the assize courts, also at Liverpool. On the 8th October he was appointed architect to the corporation for the erection of the courts, and after various meetings and the inspection of five distinct plans by him, another design showing a combination of the law courts with S. George's hall in one building was approved and adopted on the 27th October. On the 15 April 1841 the arrangements were completed for the erection of the united building. The works, in an Anglo-Greco-Corinthian style, proceeded at the end of the year at an estimated cost of £97,000, to which amount Elmes's commission was restricted; and comprised a hall 169 ft. long, 74 ft. wide between the piers, or 100 ft. across the galleries, with an arched ceiling 84 ft. high, with the civil court at one end being 50 ft. by 46 ft. 6 ins., and the crown court at the other; together with suitable rooms, offices, etc., forming a frontage of 420 ft. in length, having a portico of 200 ft. in the centre. Being advised to obtain a change of climate, he communicated his intentions with regard to the works that might accrue during his absence, to Mr. R. Rawlinson, who acted until Elmes's death; after which event Mr. C. R. Cockereil, R.A., was entrusted with the completion and interior decoration of this, one of the grandest architectural edifices in Europe. The total expenditure was ultimately about £290,000, though some accounts state that the building cost about £154,000. H.R.H. the Prince Consort inspected the works in 1846 and presented a gold medal to Elmes.

He was also one of the twenty-nine competitors who submitted 1 July 1840 their works, restricted to the Tudor style, in competition for the collegiate institution in Shaw-street, in the same town; he obtained the premium of £250, and the first stone was laid 22 October 1840; the west or principal front, 280 ft. in length, is given in the *ILLUSTRATED LONDON NEWS Journal*, 1813, ii, 18. This building having been put by the directors into the hands of a clerk of the works, was not carried out by Elmes; he, however, supplied the details without remuneration rather than have them disfigured; COMPANION TO THE ALMANAC, 1842. During the period 1840-7 he had also obtained the prize for the county lunatic asylum at West Derby, Lancashire; and had designed mansions for Mr. Geo. Hall Lawrence, then mayor of Liverpool; for Mr. Hardman Earle; and for Mr. Hugh Hornby. In a few months after leaving England, he died at Spanish Town, Jamaica, 26 Nov. 1847, aged 34 years.

ARCH. PUB. SOC.

The above is condensed from the memoir by his father read at the Liverpool Architectural Society June 1855, and given in the *BUILDING CHRONICLE*, i, 213; in which, 83, is also a description of the building; views, etc., occur in the *BUILDER Journal*, xiii, *passim*: a short memoir is given in the *CIVIL ENGINEER Journal*, xi, 64.

ELNE or SAINT ELNE, sometimes called ELENA and ELNA. A city in the department of the Pyrénées Orientales in France. The church (cathedral until 1602) of SS. Eulalie and Julie is the only edifice of importance; it was erected 1069, and is a plain Romanesque structure having the upper part in a Pointed style. A view of the apse, as well as of the choir, with seven plates of details of the richly sculptured cloister, are given in TAYLOR and NODIER, *Voy. Pitt.* (Languedoc), fol., Paris, 1837, ii, pl. 145-152.

ELOI (SAINT), see ELIGIUS (SANCTUS).

ELRETON (HENRY DE), see ELLERTON.

ELTESTER (CHRISTIAN), born at Potsdam 1672, and educated as a painter, became 1694 *hofbaumeister* and engineer to the elector of Brandenburg; he built the villas of Friedrichsthal near Oranienberg, and of Grünhoff, and several other edifices. He died in 1700. 68.

ELUTHIAS, properly EILEITHIAS.

ELVAN. A term applied by the Cornish miners to the intruded dykes of the recent plutonic rocks which traverse the more ancient mass of the granite and the covering rocks. The elvans are of great variety of composition and of colour; but the more characteristic veins are formed of "a fine grained compound of felspar and quartz, with crystals of mica"; DELABECHE, *Geological Observer*, 1851. They often contain fragments of other rocks, such as slate, gneiss, schist, etc.; and their intrusion deranges the course of the metalliferous lodes of the older formations. This term is found in the *Illustr. Catal.* of the Exhibition 1851, i, 137, as "porphyry or elvan-stone"; which is explained by ANSTED in a note to the same work, i, 138, as elvan or porphyritic dyke; and it also is mentioned as "a coarse elvan or porphyry which occurs in the parish" of S. Hilary in Cornwall, in the *BUILDER Journal*, 1856, xiv, 366. URE, *Dict.* s. v., 4th edit. G. R. B.

ELVAS (Sp. *Helvas* or *Yelves*). A highly fortified city of the province of Alemtejo in Portugal. It acquired the rank of city by royal grant 1513, and of an episcopal see 1570. The streets, generally narrow, crooked, and dirty, lead to the three strong gates, one of which only is open to strangers. A great part of the city consists of Moresque houses with arched fronts, latticed windows, verandahs, and flat roofs; and the Portuguese dwellings display great taste. Many of the habitations have piazzas in front. The parish church, dedicated to Sta. Maria, which became the cathedral, is a mixture of Moresque and Pointed art; it is approached by a long flight of steps; the capella Mór was erected by the same masons who built Mafra. Of the five parish churches, the most interesting is that of S. Salvador, formerly belonging to the Jesuits. The aqueduct (altogether fifteen miles in length) crosses the valley of the Campo de Feira, six furlongs wide, by four ranges of Moresque arches, the lower ones being nearly 100 ft. and the upper ones about 40 ft. high, thus presenting a total elevation, allowing for the thickness of the arches, of about 250 ft.; but this description is very different to the accounts, discrepant in themselves, given by MIÑANO, *Diccionario*, s. v., and by the authors named in HOFFMANSEGG, *Voyage*, 8vo., Paris, 1805, p. 265, all of whom seem to agree that the source at la Moreira is only about three miles to the east of the city. 50.

ELY. A city in the Isle of Ely in Cambridgeshire. The navigable river Ouse is here crossed by a cast iron bridge 136 ft. long, of two elliptic arches, each 42 ft. 6 ins. span, by J. Glynn, C.E., given in HANN and HOSKING, *Bridges*, 8vo., London, 1843, pl. 72-5, cxi. A monastery was founded 673, and the city formed into a bishopric in 1108. The portions remaining of the conventual buildings are now mostly occupied as

private residences; many of the ancient crypts remain under the present erections. The almonry has some remains of Norman vaulting. The deanery, supposed to have been the refectory in the latter part of the thirteenth century, has but few remains of the original building existing. The prior's lodge adjoins, and in it is the window formerly belonging to the ancient hall of the prior. Prior Crawden's chapel, built 1321-41, having a crypt under it, is considered by RICKMAN to be "one of the most curious and valuable Decorated remains in the kingdom: its ornaments are of the best character and well executed, and the whole design is of great excellence"; it was restored 1845-47; *BUILDER Journal*, ix, 243, 251; WILKINS, in *Archæologia*, xiv, 105; the principal patterns of the pavement were engraved by W. FOWLER in 1801, with a description. Ely Porta, the porter's lodge, dates in the latter part of the fourteenth century; the large room over the gateway is appropriated to the use of the king's grammar school, founded 1541. The entrance on the north side of the cathedral is part of the ancient sacristy. The remains of arches near the south transept of the cathedral have been supposed by some to have formed part of the old conventual church erected 970; and by others to have been part of the infirmary erected subsequent to the nave: there is an attached chapel similar to that at Peterborough. A fine barn of the thirteenth century, taken down in 1843, is illustrated by WILLIS, *Descr. of the Saztry Barn at Ely*, 4to., Cambridge, 1843. The bishop's palace, of red brick with stone dressings, belongs to the end of the fifteenth century; the gallery, 100 ft. long, adjoining the western wing, was erected 1550.

The cathedral was commenced 1083; of the works completed 1106 the lower part of the transept only remains; the nave, of Norman architecture, was completed 1174; the western tower was begun a few years later, and finished to the first battlements about 1189; the west or Galilee porch, a fine example of the Early English period, dates 1197-1215, having been completed five years before the commencement of Salisbury cathedral. The semicircular apse of the old choir was taken down 1235, and the six eastern arches finished 1252. The square central tower fell eastward in 1322, and demolished three of the choir arches; the octagon or ante-choir was directly commenced as well as the rebuilding of the arches; the stone work of the octagon was finished 1328, and the wood work and roof about 1342; the choir stalls are of about the same date; Alan de Walsingham is named as the designer of these parts: an octagonal story 64 ft. high was added 1380 to the western tower: to sustain this additional weight, it was found necessary to strengthen the piers and arches, by casing them with stone in 1405, and again more effectually in 1454. The north wall of the nave was repaired in 1662; part of the north transept having fallen was carefully rebuilt in 1699 by Sir C. Wren; and the cloisters were destroyed in 1650, a portion of the north-east angle, however, remains. The clearstory windows of the choir are original; those of the aisles and triforium were inserted in the fourteenth and fifteenth centuries. The building, now the Lady chapel, has been considered to be the chapter house. This edifice, erected 1321-49, now used as the church of the Holy Trinity, is without aisles, and is internally 100 ft. long, 46 ft. wide, and 60 ft. high to its vault. It is a fine specimen of the Decorated period, and is presumed to have been designed by Alan de Walsingham, who laid the first stone. Bishop Alcock's chapel dates 1488, and was partially restored in 1850; *BUILDER Journal*, vii, 150. Bishop West's chapel, cir. 1530, has the vaulting executed in the Italian style of architecture, then being introduced into England; *Illustrations*, 1857-8, s. v. CEILING; WYATT, *Metal Work*, fol., London, 1852, pl. 50.

Amongst the more modern works to this cathedral, it may be noticed that the east end, which had fallen forward two feet, was restored to the perpendicular about 1760, by J. Essex, who 1759-70 repaired the lantern of the central tower and effected other improvements. Very considerable repairs have been made

since 1830, by John Bacon, clerk of the works, under the direction of dean Peacock; *i. e.* the transepts repaired, the roofs repainted, the ruined chapel of S. Catherine rebuilt, the eastern portion restored, and the floor of choir laid with marble and encaustic tile. In 1847 the Purbeck marble piers of the choir were carefully repaired with Purbeck fragments embedded in melted shellac and polished; and in 1850 the south-east transept was repaired, the roof repainted, and a wall closing the arches of the west aisle taken down; the east side is used as a library; about 1850, also, the south-west transept was opened to the tower and restored; and a new font was supplied. The following works have been done under the direction of G. G. Scott: the choir screen of oak, 1852; the brass gates and grilles; the stalls and lower seats, with the statuettes therein, 1853; the wrought iron gates at entrances to the choir aisles, 1856 and 1859; and the reredos of alabaster and clunch, 1857. During the repairs of late years upwards of sixty windows have been filled with stained glass by various artists. The grave of G. Basevi in the north aisle of choir is covered by a brass.

The interior dimensions are 517 ft. from west to east, comprising the Galilee 40 ft.; the tower 48 ft.; the nave 203 ft.; the octagon 71 ft. 6 ins.; the choir 123 ft.; and the retro-choir 31 ft. 6 ins. The width of the nave and aisles is 75 ft. 6 ins.; that of the choir with the aisles, 74 ft. 5 ins.; the height of the choir is 70 ft.; of the nave, 72 ft. 9 ins. The length of the transepts is 178 ft. 6 ins.; their breadth with the aisles, 73 ft. The clear diameter of the octagon is 65 ft. 4 ins.; height of pillars, 62 ft.; of the vaulting, from the capitals to opening of the lantern, 32 ft.; of the lantern, 48 ft.; clear diameter of the lantern, 30 ft.; total height to centre of lantern, 142 ft. Externally the height of the four stone turrets of the west tower is 215 ft.; of the lantern, 170 ft.; of the two towers of south-west transept, 120 ft.; of the east front, to the top of the cross, 112 ft.; and of the roof over the nave, 104 ft.

The stone of which the cathedral is constructed is mostly from Barnack near Stamford; some of the interior work is of Purbeck marble, and clunch (a soft white stone) from Burwell in Cambridgeshire. The ribs of the vaulting of the Galilee are of Weldon stone, but the filling-in is of clunch. The bed of the ancient river by which the stone was conveyed during fen floods, and the wharf at which it was landed, are still visible on the south side of the cathedral. The *BUILDER Journal* gives notes of a lecture by WILLIS, v, 504; also ix, 243, 450; a paper by DAVIS, xv, 535, 548; the south-west transept, ix, 75; a view of the Galilee porch, v, 374; an early doorway, restored in 1847, v, 495; and of the east end, v, 383-6; new screen, ix, 451; and gates, 498.

The city also comprises the following buildings: S. Mary's church, built in the early part of the thirteenth century, on the site of a former church; the shire hall and gaol, 1821, by C. Humphrey; Parson's almshouses, 1845, by G. Basevi, who enlarged the gaol, 1845; the railway station, 1846; the cemetery chapels, 1855, by — Pritchett; and the national schools, 1859, by S. S. Teulon. MILLERS, *Descr. of Ely*, etc., 8vo., Camb., 1805; 1807; and 1834; *HANDBOOK to the Cathedral Church*, 8vo., Ely, 1852; BENTHAM, *Hist. and Antiq. of the Cathedral*, 4to., 1771; with suppl. by STEVENSON, 4to., Norwich, 1817; WINKLES, *Cathedrals*, 8vo., Lond., 1836-42, ii.

ELYAS. A person so called is recorded in a writ presumed to be of the 10th Richard I, 1199, as 'Elyæ Ingeniatori x marcæ ad reparacionem Domorum Regis apud Westmonasterium per breve H. Cantuariensis Archiepiscopi'; MADOX, *History, etc., of the Exchequer*, fol., Lond., 1711, p. 677, from Mag. Rot. 10 R. I, Rot. 12a, Lond. and Midd. WALPOLE, *Anecdotes*, 8vo., Lond., 1762, cites this (but with the erroneous date 1209, for archbishop Hubert died 1205) as the earliest evidence of art in our records, translating the term ingeniator as 'engineer or architect'; and he is followed by BRAYLEY and BRITTON, *Westminster*, 8vo., London, 1836, p. 24. It might perhaps be possible to connect this Elyas, with the Elyas de

Derham who was one of the executors of the will of the archbishop, and receiver for the king during the vacancy of the see, as appears from a series of memoranda dated 1205-13, in *HARDY, Rot. Litt. Claus.*, fol., London, 1833; 42, 43, 44, 46, 61, 92, 146.

ELYAS, see BERHAM and DERHAM (ELYAS DE).

ELYNG. An old mode of writing AILE or AISLE.

EMBANKMENT and EMBANKMENT WALL. An embankment is an artificial mound which serves as a margin to a sea, river, lake, or reservoir; or supplies a means of passage, as in raised roads; or combines both purposes, as in the case of a pier, or of a quay. It necessarily follows that the details of its formation, and the mode of protecting its exposed surfaces, must vary in almost every instance.

If requisite at any time to form a lofty embankment, it is essential to ascertain, before commencing its execution, whether the subsoil of the ground, on which the bank is to be raised, be susceptible or not of lateral displacement under the proposed superincumbent weight. For instance, on the Paris and Versailles railway, near the Val Fleury, and on the Great Western railway at Hanwell, the subsoils compressed partially under the load of the banks, but at the same time they slipped laterally, and were forced up to a considerable height upon the sides of the new materials. Accidents of this description are of very frequent occurrence upon the shores of large bodies of water; and they constitute indeed the most serious difficulty in the execution of that class of operations. The best modes of obviating this tendency to lateral displacement seem to be, either to isolate the seat of the embankment from the surrounding strata by means of a continuous range of sheet piling; or to spread the weight over as large a surface as possible by means of long flat slopes, and of stepped sides; or to distribute the weight by the introduction of some homogeneous description of material at the bottom; or to diminish the weight by interspersing fascines, bundles of reeds, or other similar substances, in the heart of the embankment. Local circumstances must guide the choice of the particular method to be adopted; the essential condition being that the momentum of the embankment should not be so great as to overcome the friction of the layers of the subsoil upon one another. Clay lands, where the clay is occasionally interspersed with beds of sand, alluvial formations, ancient morasses, etc., may be cited as particularly exposed to this class of accidents; and it is very desirable that numerous borings should be taken over the intended seat of any embankment to be formed upon them, previously to commencing the execution of the works. These borings should be carried to a considerable depth from the surface, especially if there should exist any subterranean water courses under the proposed seat of the embankment.

The nature of the materials of which an embankment is formed will affect the profile to be given to its cross section, and also render it necessary at times to adopt certain precautions in the execution of the work, in order to avoid settlements or compression. Clay land, for instance, when carried to bank, will be liable to slip if the slopes are made with an angle of more than 26° (or with slopes of 2 to 1); whereas gravel, dry sand, broken stone, chalk, etc., will stand with slopes forming an angle of about 34° (or as 1½ to 1). The slope at which materials will just stand has been called the angle of repose. If an embankment be formed in dry weather, it will always be exposed to settle by the mere effect of the subsequent infiltration of the rain, which will carry the finer materials into the interstices of the larger ones. This inconvenience is the most distinctly felt in embankments formed of the materials extracted from cuttings in stone or rock, and the least distinctly so in embankments formed of sand. As a general rule, it is advisable to calculate upon the compression of earthen banks, executed by waggon work, and by what is known as the "flying tip", at the rate of $\frac{1}{10}$ of the finished height when the latter does not exceed twenty feet; but the manner in which the earth is deposited must so mate-

rially affect the rate of compression, that it would be dangerous to establish any invariable rule of this description. Formerly the embankments required for canal purposes, for instance, were carried up in thin layers, and the surface of each of these layers was carefully rammed before the next one was added; and in the specification for the main drainage of the metropolis (northern high level sewer), 1858, the embankment to form the foundation for the outlet sewer towards Barking Creek is described to be formed of clay in layers not exceeding 6 ins. in thickness, well mixed with water, and punned down with an iron punner not less than 10 lbs. in weight. In military engineering the same system still prevails; and evidently, when it is carried out carefully, the compression of the ground must be considerably less than when, as in the formation of railway embankments, the earth is simply shot out of a cart or waggon. An embankment formed by cart-work will usually settle less than one formed by waggon-work; but it would certainly be suspended during the continuance of wet weather.

Embankment upon or around bridges or culverts should be formed in such a manner as to distribute the weight on either side of the arch in equable proportions; and precautions must be taken to prevent the thrust of the foot of the embankment from displacing the foundations of the abutments.

It is essential that the surfaces of both the top and the slopes of a lofty embankment should be protected from the effects of rain, by the execution of a complete system of drains, or by dressing the surfaces in such a manner as to throw off the water; and as there is greater danger of the lateral displacement of the bank, in consequence of the infiltration of water under its seat, than from any other cause, especial care should be taken in forming the bottom ditches. The drains upon the surfaces of the top and sides of the embankment must always be formed in such directions, and of such materials, as to obviate any danger of ravinement by the flow of the water they may discharge; and they should, if possible, always be carried at once into the outfall ditches.

In designing earthworks, the principal difficulty arises from the necessity which usually exists for balancing the amounts of the excavation and of the embankment. If there should be an excess of earth in the cutting, beyond that which is required for the bank, it is 'carried to spoil', or thrown into a heap; if, on the contrary, there should not be enough earth, it must be obtained from what is called 'side cutting'. But it is essential to observe, in forming the latter, that occasionally the disturbance of the surface strata may alter the conditions of equilibrium of the latter, and thus expose them to slip. In alluvial lands, especially, it is dangerous to form the chambers of side cuttings at the feet of the slopes of the bank; for the removal of the weight of the earth so extracted will certainly increase the tendency of the surrounding earth to slip. It must always be a matter of calculation, in designing an embankment, to discover whether there be or be not an economy in the application of either of the above mentioned modes of disposing of the materials of a cutting, or of forming a bank; or whether, after all, it would not be more advisable to substitute masonry viaducts for earthen banks. In cases where the latter cross the valleys of large rivers it may often be necessary to form so many navigation, or flood bridges, as to modify the results of the comparative estimates in a serious manner.

If the foot of an embankment or the surface of the slopes should be exposed to the action of running water, they must be protected by either covering them with a pitched slope of stone, or by a matting of fascines, of reeds, or of wattling. The former system is adopted in localities where stone is easily obtained; and the principles to be observed in the execution of the pitching are, that the materials of which it is composed should be such as to resist the effects of frost, and of occasional immersion, bearing in mind always that the capillarity of the stone will cause the water to rise in it above the actual water level. Moreover, the size of the stones used must depend upon

the amount of the mechanical force they are called upon to resist; for if the velocity of the stream should be great, or there should be a danger of its rising in waves, larger stones must be employed than would be the case if the waters were tranquil. Upon the sea-shores of Holland, however, the whole of the embankments are executed in sand, but in such cases the slopes are made extremely flat, varying between 5 base to 1 rise, to 10 base to 1 rise occasionally; whilst upon the shores of the Thames, in cases where the face of a long exposed foreshore is even covered with concrete and wattling, the inclination of the exposed surfaces is made equal to 4 base to 1 rise. On the banks of the Rhine, fascines are almost exclusively used; and a very elaborate description of the manner in which they are employed may be found in an article by DEFONTAINE, inserted in the *Annales des Ponts et Chaussées* for 1833. In Holland a modification of the same system is employed in the fresh water districts; and a description of it may be found in MINARD, *Cours de Construction, etc., pour les Rivières et Canaux*. It may perhaps be as well here to add that in some cases, as on the banks of the Adour, in the south-west of France, the feet of the embankments were protected by means of plantations of semi-aquatic trees; but of course there is the danger that such trees would not grow with sufficient rapidity to allow temporary protection to be dispensed with. There is no English work treating specially upon embankments, but a great amount of miscellaneous information will be found in the various scientific periodicals: amongst others, the CIVIL ENGINEER *Journal*, 1841, iv, 395, notices the paper on embankments and retaining walls by HARTLEY, read at the Institution of Civil Engineers; the same *Journal*, 1844, vii, 263, 400, gave some formulae by ROBERTS for calculating the sectional areas of excavations and embankments; and 1848, xi, 197, published the calculations by CLARK relating to stone walls and embankments for reservoirs of water. RITCHIE, *Railways, their Rise, etc.*, 8vo., London, 1846, p. 175, gives the method adopted for embanking on Chat Moss, on the London and Manchester line of railway. WIGGINS, *The Practice of Embanking Lands from the Sea*, 12mo., London, 1852.

Unless in cases where an embankment is entirely formed from side cutting, it is considered that the price paid for the excavation covers the value of the work in forming the embankment likewise; excepting, however, that the dressing of the slopes; the forming of the surface to receive the ballast, or road metal, as the case may be; the formation of any puddle trench, or of any puddle bed for a canal; are paid for in addition. ANGLE OF REPOSE; BATTER; CRADGE; EARTHWORK; EXCAVATION; RETAINING WALL.

G. R. B.

EMBATTAILMENT, see BATTLEMENT.

EMBATTLED FRET, see FRET.

EMBLEM. This term, derived from the Gr. *ἔμβλημα*, meaning something inserted or engrafted, was originally applied in the words 'emblematic work' to mosaics, and to inlaid woodwork, as well as to some species of metal work; it has even been explained as meaning ornaments that could be applied or removed as occasion might require. In its modern acceptation, the word, as meaning something inserted or engrafted, was applied to the material expression of an idea; i. e. to a pictorial or sculptured allegory: and, by an improper application of the word, it is frequently employed instead of SYMBOL or (more properly sometimes) ATTRIBUTE; as in the cases of PUGIN, *Glossary*, 4to., London, 1840, s. v. *Emblems of Saints*, etc.; and of HUSENBETH, *Emblems of Saints, by which they are distinguished in Works of Art*, 2nd edit., 12mo., London, 1860. For example, an armed female figure holding a trident and attended by a lion, is more precisely recognized as the emblem of British dominion by the symbolical crosses upon the shield, than by the attributes of the trident and the lion. For decoration, except in Italy, the modern architects since the eighteenth century have not much followed the mediæval system of placing in conspicuous parts of their buildings the *imprese* or symbols

or devices assumed by great families; as the balls of the Medici, the column of the Colonne, the bear of the Orsini, the ladder of the Scala family, etc.

EMBOSSSED WORK. This term, derived, with EMBOSSEMENT, from the Fr. *bosse*, a prominence, has been explained as work which has a general protuberance of the main body of the work from its frame, as in the cases of a mask from a patera, and of the umbo from a shield: and also as work in relief, as opposed to emblematic or inserted work: so that embossment is sometimes explained as the projection of sculptured work from its ground.

1.

At present the term is restricted to work of wrought metal in relief, the prominent parts of which have been 'embossed' or driven up from the under side of the metal plate. The word is used in contradistinction to 'chased' or 'enchased' work, in which the reliefs are obtained by punching down from the outside face of the metal the lower parts of the subject, and leaving the higher parts in their original position. The plates in both instances, before being worked, are bedded on a ground composed of pitch, and other similar substances, which yield to the stroke of the tool without breaking the metal plate.

A. A.

EMBRASURE (It. *canoniera*). The portion, widening inwards for the purpose of discharging missiles from the wall or parapet of a fortification; the term is sometimes improperly applied to the crenel or notch in an embattled parapet, whereas there may be a loophole or oilet with an embrasure behind it in each cop, while the crenel may have no embrasure. In the old French dictionaries, s. v. *embrasement*, which seems to have been synonymous with embrasure, notice is taken that the word ought to have been *ébrusement*; that the enlargement which it expresses might be on the outside, as well as on the inside either of a door or a window; and that the enlargement might take place on one elbow or jamb or on both, on the lintel, and on the sill or back: in England the word has also been adopted for the enlargement on plan of the interior recess of a window opening.

1. 19.

EMBREE (JOHN), Esq., "Surveyor of his Highnesses works within the Tower of London, pt. upon his yearly salary of ecclrs. for one quarter of a year ended the 29th day of September 1657; lxxvi." Like payments were made on 25th Decr. 1657, and 25th March 1658. Brit. Mus. Addit. MSS. 18,765, *Eschequer Papers*, Plut. cxliii, H., p. 29, 38, 44. EMERY.

EMBRUN. A city in the department of the Hautes Alpes in France. Walls and ditches still surround the dark, crooked, and dirty streets, which are generally lined by good houses. The only edifices worthy of notice are the old *tour Brune*, of curious masonry; the *seminaire*, now the house of correction; the episcopal palace, converted into a barrack; and the church, formerly cathedral, which has a west end chequered with slabs of yellow limestone and black shale, a Romanesque tower, and a north portal having pillars of the local red marble, the two outermost pillars being based each upon a lion; the upper portion of this structure is of later date.

28. 56.

EMERALD GREEN. An opaque pigment composed of an earthen base tinged with copper. Although of a hue not common in nature, it is valuable as being the most durable of its class. It works well in water, but works and dries with difficulty in oil. It is little affected by lime, light, or oxygen, but suffers with the other copper greens from shade and sulphuretted hydrogen.

9.

EMERE (GARCIA D'). On the keystone of the archway, enclosed by an Ionic order, in the principal façade of the church of Valera de Abajo in New Castile, is the inscription "Garcia de Emere me fecit anno 1594"; and, as some portion of the church is in a Pointed style, it is manifest that he did not build the entire edifice, as is generally stated.

66.

EMERITA AUGUSTA. The Roman name of MERIDA in Spain.

EMERY (. . .). Mr. Emery, 'the State Surveyor', was invited to dine with the Carpenters' Company 28 August 1657;

JUPP, *History*, etc., 8vo., London, 1848, pp. 182, 206. He probably succeeded Francis Carter; who was made state surveyor in 1651, and the year of whose death is not known. EMBREE.

EMERY-CLOTH, see GLASS-PAPER and SAND-PAPER.

EMISSARIUM. The Latin name, for a tunnel or outlet of large size formed to lower the waters of a lake and so to bring submerged land into cultivation, which is still used in speaking of the Alban and Fucine lakes in Italy: the emissary of the former was commenced soon after B.C. 397, and that of the latter by the emperor Claudius. The tunnel from the lago di Albano or di Castello, about 8,000 ft. (but more probably 7,400 ft., although about 4,400 ft. in CANINA, *Arch. Rom.*, fol., Rome, 1840, pl. 176) in length, and worked through peperino interrupted by masses of lava, still serves the purpose for which it was made: NIBBY, *Analisi*, 8vo., Rome, 1837, i, 101-9, who has estimated the mode of executing this work within one year, differs in some respects from GELL, *Top. of Rome*, 8vo., London, 1834, i, 39-54, who shows that the tunnel is probably about 4 ft. 6 ins. wide, but that at the distance of 400 ft. from the entrance there is only 2 ft. between the roof and the present bed of the channel. This author also notices the flat entrance arch of seven voussours which has been illustrated by S. SMIRKE, R.A., in the *ARCHÆOLOGIA*, 1838, xxvii, 383, but is scarcely indicated by PIRANESI, *De Rom. Magnif.*, fol., Rome, 1761: the date of this arch is uncertain. The tunnel from the lago Fucino or di Celano, about 15,600 ft. long and worked through a hard limestone, has been choked up almost from the time of Hadrian, who cleared it: the whole work was examined in detail, and described 1825, by a Neapolitan engineer named Rivera; the results of his researches are given by KRAMER, *Der Fuciner See*, 4to., Berlin, 1839. 23.

LEAKE, *Travels in Northern Greece*, 8vo., London, 1835, ii, 281, describes the emissaries of the Cephissus; but, although he notices the shafts to the channels, he evidently considers that this subterranean passage is natural, like the other 'katavothra' which he mentions.

EMLYN (HENRY), resident at Windsor, published *A Proposition for a new Order of Architecture, with rules for drawing the several parts*, fol., London, 1781; this consisted of a shaft that at one-third of its height divided itself into two, the capitals having oak leaves for foliage, with the star of the Order of the Garter between the volutes. This order (the point of division being covered by an escutcheon, and the foliage being replaced by ostrich plumes) he used in the tetrastyle portico at Beaumont lodge near Windsor, erected, except part of the west wing, by him for Henry Griffiths, esq., about 1785; NEALE, *Views*, 4to., London, 1818, i: and in the porch of the house in which he himself resided. The restoration 1787-90 of St. George's chapel, at the expense of George III, included the screen (praised by WILLEMENT, *Account*, 4to., London, 1844, p. 21, who says it is of cement, and calls him 'Evelyn') to the choir, executed in Coade's artificial stone, with the organ case, the altar, and the king's and additional stalls. A tablet in the Bray chantry there is thus inscribed: "Near this place lie the remains of Mr. Henry Emlyn, architect, F.A.S., from whose designs, and under whose superintendence, this chapel was repaired and beautified by command of his Majesty King George III: he died the 10th of Dec. 1815, aged 86 years." GENTLEMAN'S MAGAZINE, 1815, ii, 573.

EMPARAN (SANCHO DE) commenced the construction, or at least began to rebuild in a Pointed style, in 1418, according to an inscription on the façade, the parish church of Sta. Maria at Guernica in Biscay, which was not completed until 1625. 66.

EMPLECTON (Gr. ἐμπλέκω, plait, interweave) has been described by modern writers as a kind of masonry in which two thin walls are run up, and the interval filled with concrete or rubble: this is an error not readily detected by a non-professional eye. PLINY, *H. N.*, xxxvi, 51, treating of the different sorts of walling among the ancients, specifies, 1, *isodromum*, or

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work on level beds where the courses are of equal height; 2, *pseudisodromum*, or work where the courses are all on level beds but are unequal in height, *random coursed work*; 3, *emplecton*, "tantummodo frontibus politis, reliqua fortuito collocant", i. e. the faces of the wall only being worked, and the rest laid at hazard; but he goes on to say that bond (commisuræ) should be made in the middle of the wall (in medio quoque pariete). This work answers exactly to our *random faced work*, where the stones are not coursed, but simply worked fair in face, and rough bonded through the thickness of the wall. PLINY then describes, 4, *diamicton*, two walls run up and filled in 'stuffed' with broken stone (medios parietes farcire fractis cæmentis). This is the work which all modern writers have called emplecton, but evidently is not so, as it is composed of two thin faces and a hearting ('stuffing') of concrete of broken stone, and not bonded through. He then describes, 5, the *opus reticulatum*, upon which there is no doubt. The passage in VITRUVIUS, ii, 8, has evidently the same meaning, though it is not quite so clear, as he omits the word *diamicton*. He however mentions, 1, *isodromum*; 2, *pseudisodromum*; 3, *emplecton*, of which he says "cum frontes moluntur reliqua (ita uti sunt nacti) cum materia collocata alternis alligant coagmentis", i. e. the faces are worked, but the rest of the wall as it may chance is put together with alternate bond; and 4, adds that the Italians, as desirous of saving time, put up two 'skins' (coria) make them serve for faces, and 'stuff' (farciant) the middle of the wall with broken pieces; so that there are three thicknesses, two faces and one middle stuffing (duæ frontium et una media farcturæ). This is clearly the 4 of PLINY, the *diamicton*, although VITRUVIUS does not expressly call it by that name. It seems clear that emplecton was exactly random work laid without courses, the face only tooled, the rest of the wall being of rough stones laid with a sort of bond; while the other work, *diamicton*, perhaps coursed (erecta coria locantes), was filled in with broken stone like concrete. VITRUVIUS further adds that the Greeks did not practise this sort of work, but placing flat courses, 'plana coria locantes', not only bonded the stones well together, but introduced 'diatonoî' or through-stones. DIAMICTON; DIATONOS. A. A.

EMPULUM. The modern AMPIGLIONE in the Papal States.

EMROD or EMBRY. An old name for a glazier's diamond. GROZING IRON. 4.

ENAMEL (in late Latin, *opus anamelatum*, RYMER, *Fœdera*, fol., London, 1710, x, 433; It. *smalto*; Sp. *esmalte*; Fr. *émail*; Ger. *schmelz*). This term has had seven significations; viz. 1, a mode of painting in which the body and colours are submitted to a great heat, when the colours either melt or (if they do not quite fuse) assume so exceedingly firm a state of paste that they seem to have been melted; 2, the glass, generally opaque or coloured, which is formed by the combination of proper metallic oxides with some fixed fusible salts, as a flux, to render it fit for this employment upon earthenware, glass, or metal; 3, the flux itself, which is a transparent colourless substance generally composed of oxide of lead and silex fused together, with the addition of a small quantity of tin if the flux is intended to be opaque; 4, the ground or body, prepared with the flux, which may receive such painting; 5, the semi-fused paste; 6, the complete work itself; and 7, by a sort of analogy, the art of producing a surface of variegated colours by materials laid into or upon some ground.

It will be seen that enamelled slate, if it be merely japanned or lacquered ware dried at so high a temperature as 300° to 500°, can only claim the epithet by virtue of this last, and improper, extension of the use of the word. Earthenware, with a glazed surface produced by lead or by salt, is truly enamel; as is also all painted glass that has been properly fired. The term is here noticed on account of the lustrous but opaque coating, improperly termed a glaze, which has been applied to cast iron ornaments, pans, pipes, etc., under Hickling's patent, granted December 1799; and Clarke's patent,

granted 28 May 1839; but chiefly under Kenrick's patent, granted 26 May 1846: the process of the last named manufacturer is noticed in the *BUILDER Journal*, 1847, v, 16, as well as in the *CIVIL ENGINEER Journal*, 1847, x, 27 (which, xii, 302, mentions other receipts by Stumer); Wyatt's process, patented 18 October 1850, is described in the same *Journal*, xiii, 231; and another is noted in the *BUILDER Journal*, 1858, xvi, 879. An account of the different species of enamel and damascene work of the middle ages is given by ROGERS, *History*, in the *Journal of the British Archaeological Association*, 1848, iii, 280; and by WYATT, *Art of Enamel*, in the *CIVIL ENGINEER Journal*, 1848, xi, 156; and in his *Metal Work*, fol., London, 1852, p. 145. AMAASA; AMEL or AMMEL.

ENAMEL BLUE or ZAFFRE. A cobalt blue. 9.

ENAMELLED, ENCAUSTIC, and GLAZED TILE. The mediæval tile for pavements, made in the north of Europe with a yellow pattern on a red ground, had the lighter portion formed by white clay pressed into the cavities of a stamped red clay, the yellow tinge being given by a lead glaze. The mediæval tile of Southern Europe and of the East was painted in enamel like those of Holland in the sixteenth century; thus the proper names of these processes, repeated by existing manufacturers, left room for a reasonable addition of the term *encaustic* for the modern tiles in which a stamped pattern is filled with various coloured materials, and produces during the firing the required tints.

ENCABO, see MARTINEZ DE ENCABO (JUAN).

ENCARPUM or ENCARPUS. This term (derived from the Gr. ἐν, in, and καρπός, fruit) is only found once in VITRUVIUS, who, iv, 1, using it in connection with 'cymatium', in his fanciful account of the invention of the Ionic order, might be supposed to have intended to suggest the idea of fillets and flowers. Consequently the word has been allotted in turn to all sculptured foliage in the Ionic capital; and by GWILT, *Encyc.*, s. v., as the general name for "the festoons on a frieze consisting of foliage, flowers, fruit," etc.

ENCAUSTIC (Gr. ἐγκαυαίς, from ἐν, in, and καίω, I burn). An ancient term for several processes of painting in which the execution was accomplished by the application of heat. This is known from PLINY, *H. N.*, who, xxxv, 39-41, has the phrases 'ceris pingere ac picturam inurere'—'*encausticæ picturæ*'—'*Pamphilus quoque Apellis præceptor non pinxisse tantum encausta sed etiam docuisse traditur Pausan Sicyonium primum in hoc genere nobilem*'—and '*encausto pingendi duo fuisse antiquitus genera constat cera et in eboræ cestro id est viriculo donec classes pingi cœpere hoc tertium accessit resolutis igni ceris penicello utendi*'. Attention should also be given to the statement of the same writer, xxxv, 31, '*ceræ tinguntur iisdem coloribus ad eas picturas quæ inuruntur alio parietibus genere sed classibus familiari*', in connection with his term *cera*, xxi, 49, '*parietum—tutelam*', and with his notice, xxxvi, 64, '*figlinum opus encausto pinxit*' as applied to the thermæ of Agrippa. OVID, *Fasti*, iv, 275, says '*picta coloribus ustis cælestium matrem concava puppis habet*'; and MARTIAL, iv, 47, '*encaustus Phaëthon tabula depictus in hac est: quid tibi vis dipyron qui Phaëthonta facis*'?

The encaustic process was supposed to be the same as that of enamel, but in the last century the words of PLINY were held to intimate clearly that heat was in some manner always applied, and obscurely that wax was used either as a ground, as a vehicle, or as both; although Hardouin in his note to PLINY, xxxv, 41, had shewn that *ceroma* might mean a process of painting with wax as a medium, some writers were still disposed to think that *cera* for that purpose meant a composition into which bees-wax did not enter. Yet it would seem impossible that reference could have been made to the clear directions of VITRUVIUS, vii, 9, who says in sufficiently plain language that whoever wishes a colouring coat to retain its tint of minium should, when the wall is coloured and dry (his preceding sentence shows that he expected this to be the case in two or three days

after the colouring was done), coat it well by a brush (of bristles) with Punic wax melted by fire and slightly tempered with oil; should afterwards force that wax thoroughly to sweat by making the wall hot by applying charcoal placed in an iron pan (perhaps galea should be read instead of galla in PLINY, xxxiii, 7), thus making the wax become a coat even in thickness everywhere; and finally should dress it down with a torch (or rather candle) and clean cloths, in the way that nude marble statues were finished. He states that this process was called *καῦσις* by the Greeks, and that the defensive coat of Punic wax did not allow the moon's beams or the sun's rays to cause the colour to fade from the finished work. PLINY, xxxiii, 7, speaking of minium, has simply condensed the passage: he says '*solis atque lunæ contactus inimicus remedium ut pariete siccato cera Punicæ cum oleo liquefacta candens setis inducatur iterumque admotis gallæ (galeæ) carbonibus aduratur ad sudorem usque postea candelis subigatur ac deinde linteis puris sicut et marmora nitescunt*.' The same author, xxi, 49, has, moreover, given the receipt for making the Punic wax, which may be compared with Dioscorides, ii, 106.

The above may be taken as explanatory of the usual process for walls, but there is only the above passage from PLINY, xxxv, 31, to show that there was a process applied to ships and pictures in which the wax was mixed with colour and applied at once; this is also stated by VARRO, *R. R.*, iii, 17, who alludes to the boxes in which painters kept the '*discolores ceræ*', various coloured wax. The process on ivory is not so clear. ATHENÆUS, v, 30, speaks of vases that were *κέκρογραφημένα*, but less is known of this process of painting on pottery than even of the other methods.

Among those who accepted the common translation of *cera*, BACHEMIER in 1749, as well as CAYLUS at the Academy of Painting in 1752 and 1754, had painted in wax when REQUENO, *Saggi sul Ristabilimento dell' Antica Arte*, 2nd ed., 8vo., Parma, 1787, and LORGNA, *Un Discorso sulla Cera Punica*, Bologna, 1785 (reprinted in the Appendix, 8vo., Rome, 1806, to that work), communicated experiments which led to a severe critique in the work *Osservazioni intorno al Discorso*, etc., *del Sig. Colonn. Cav. Lorgna*, 4to., Verona, 1785.

The predictions of the anonymous author of this pamphlet have been fulfilled: after the discovery of various methods of rendering wax a vehicle valuable to the painter, the matter seems to have settled into an acknowledgment that in consequence of the almost uniform failure of the various modern processes it may reasonably be doubted whether any of them are the same as those of the Greeks. The fullest outline of the history of these attempts is given by EASTLAKE, in the *Report of the Commissioners on the Fine Arts*, 1844, reprinted in the *CIVIL ENGINEER Journal*, 1844, vii, 350; with another notice, 1846, ix, 337; and several complementary facts are contained in ELMES, *Dict.*, 8vo., London, 1826, s. v., as well as in DUSSAUCÉ, *Notice sur la Peinture Encaustique*, 8vo., Paris, 1845. ENAMELLED TILE. 6. 14.

ENCHASED. A term applied to work of wrought metal in relief, the prominent parts of which have been obtained by punching down from the outside face of the metal the lower parts of the subject, and leaving the higher parts in their original position. The term is used in contradistinction to EMBOSSED WORK, and does not mean, as stated in BRITTON, *Dict.* s. v., "ornamented with figures in low relief", but that a work has been decorated with ornament upon which the tool of the CHASER has been employed.

ENCINAS (ALONSO DE), a pupil of J. B. Monegro, showed considerable ability in the construction of the chapel of Nuestra Señora del Sagrario in the cathedral at Toledo. As the design is also attributed to the younger Vergara, his reputation chiefly rested, however, upon the handsome two-storied cloister of the '*mercenarios calzados*', which was one of the best works in that city, and was completed by him 6 January 1624. 66.

ENCLOSURE (It. *recinto*; Sp. *cercada*; Fr. *enclos*). A

piece of ground surrounded by a hedge, a paling, or a wall.
PARTITION; SCREEN. 5

ENCRINITAL MARBLE (Gr. *κρῖνον*, white lily, and *εἶδος*, form). This, sometimes called Derbyshire marble, because it is procured to a considerable extent in that county, is principally formed of carbonate of lime cementing together the fossilized remains of the zoophytes called crinoidæ (including encrinites and pentacrinites) from their resemblance to the closed head of a lily. The number of bones in the skeleton of one of these creatures is computed to exceed thirty thousand; detached, these bones occur in myriads in the mountain limestone and transition rocks, where they form successive strata each many feet in thickness and miles in extent. 70.

ENCYCLOPÆDIA, see DICTIONARY OF ARCHITECTURE.

ENDIANDRA GLAUCA, see TEAK WOOD.

ENDIRON. The name given in Yorkshire to a moveable iron plate used, singly or in pairs, to contract the width of a grate or other fireplace. ANDIRON. 19.

END OF TIMBER. The English forest term for a 'stick'.

ENDOSMOSE. The attraction of a thin fluid through a closed animal or vegetable membrane, by a denser fluid. This term, with its opposite 'exosmose', has of late been applied in a more extended sense, *i. e.* when the medium through which the fluid is to pass is of any material used in building; *e. g.* in the case of gas-pipes, as stated in a discussion upon a paper read at the Institution of Civil Engineers, by A. A. CROLL, and given in the *CIVIL ENGINEER Journal*, 1845, viii, 173-5.

ENDOWED PUBLIC CHAPEL. A chapel, endowed with landed or funded property vested in trustees, for the maintenance of the building and for the support of a priest or curate. Its rank is shewn in the words "parish, perpetual curacy, donative, endowed public chapel, parochial chapel, and chapel or district belonging or annexed to any church or chapel"; 1 and 2 Vict. c. 106, sec. 124. It is therefore something between a church and a parochial chapel; and the latter has the parochial right of christening, thus differing in nothing from a church but in the want of a rectory and endowment. PHILLIMORE's edition of BURN, *Ecclesiastical Law*, 8vo., Lond., 1842.

ENDOWMENT. The charter of endowment for the bishopric of Gloucester is given in RUDDER, *Gloucestershire*, fol., London, 1779. Abstracts of modern deeds of endowment for repairs, stipend and its augmentation, etc., are printed in ROBINSON, *History, etc., of Hackney*, 8vo., Lond., 1842, i, 188.

ENFANT (. . . L'), see L'ENFANT (. . .).

ENFILADE (It. *infilzata*; Sp. *ringlera*; Ger. *riche*). The French term, adopted in English for the alignment of the doors in a suite, or rather file, of rooms. This enfilade was next to the window side of the room from at least the end of the seventeenth century until the beginning of the nineteenth. ALIGNMENT. 5.

ENFRANCHISEMENT. The act of freeing or converting into a freehold, property held under copyhold or customary tenure, by the purchase of the fines and other impositions to which it may be liable by custom or other cause. The statutes which relate to this act are chiefly 4 and 5 Vict. c. 35, 6 and 7 Vict. c. 26, 7 and 8 Vict. c. 55, 14 and 15 Vict. c. 104, 15 and 16 Vict. c. 51, 16 and 17 Vict. c. 57, repealed, and 21 and 22 Vict. c. 44 and c. 94, which empower either the lord or the tenant to compel the enfranchisement of copyholds or heriots payable out of freehold lands, subject to the previous payment or tendering of the fines and two-thirds of the fees where the admittance to a copyhold or payment of a heriot has not taken place since 30 June 1853. Copyhold commissioners are appointed to carry the provisions of these acts into effect. Provision is also made for defining boundaries, providing for cases of disability, payment of expenses, and settling disputes. Enfranchisement will not affect the right of either party to the mines or minerals in the lands enfranchised, or in any other lands; and the tenant will still be entitled to his former commonable rights, although he has obtained the freehold of his

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land. From the Annual Reports of the Commissioners it appears that the terms for enfranchisement settled by them are as follows. Quit rents, twenty eight years purchase; copyholds of inheritance, fines certain, from one and a half to two and a half fines and about a quarter of a year's value; copyholds of inheritance, fines arbitrary, three to five years value, according to the age of the tenant; copyholds for lives, according to the ages of those lives; heriots three-quarters to one and a quarter of a heriot, according to the age of the tenant. And these calculations as to age are facilitated by a table furnished by the commissioners. They have also printed the 'minute' stating the object of the act; the mode of giving notice; and of applying for the award of the commissioners where the parties are agreed as to the amount of the consideration, or for the opinion of the commissioners upon the basis of an agreed net annual value; the formalities indispensable in the appointment of valuers and umpires; the kind of consideration to be awarded; and the forms of awards. The acts of Parliament are given by SHELFOED, *Law of Copyholds*, 12mo., London, 1853, and supplement, 1858, but the professional reader must substitute the above for his page 458, and will naturally prefer to obtain from time to time the necessary minute and forms from the office of the commissioners.

ENG. A strong, heavy, grey wood of Amherst, used for boat building, piles, beams, etc. 71.

ENGAGED. The adjective expressing that a column, a pilaster, a pillar, or a pier, is in part attached to another column, pilaster, pillar, pier, or wall. When one column or pillar is engaged in another, the word 'inosculated' or 'inosculating' is sometimes employed instead of 'engaged'. It may be useful to notice that the practice of engaging columns (to say nothing of pilasters) was not uncommon in classic art, *e. g.* in the temple to Minerva Polias at Athens; in the temple to Æsculapius at Agrigentum; and in the temple to Jupiter Olympius at the same place, where the columns are attached to the walls of the naos and have a corresponding pilaster within. A column half engaged in a pier was found at Delos; and at the temple to Apollo Epicurius at Basse. There were at least three examples of half columns placed one on each side of a pilaster or pier; viz. the curious example at Halicarnassus; the almost similar example at Heraclea (not Myus); and the fragment at the island of Delos; similar to those whence LE ROY derived his oval columns. Engaged columns and pilasters are found in profusion in Roman architecture; and an interesting example of the inosculating column (Ionic) occurs at the angles of the portico of the palazzo Barbarano at Vicenza, by Palladio. STUART and REVETT, *Antiquities*, fol., London, 1762-1816, supplementary volume, fol., London, 1825; PIETRASANTA, *Le Antichità della Sicilia*, fol., Palermo, 1834; SOCIETY OF DILETTANTI, *Ionian Antiquities*, fol., London, 1769-97, ii.

ENG-BENG. A strong wood of Tavoy, East Indies, used for house carpentry. 71.

ENGELBERGER (BÜRKHARD) of Hornberg in Wurtemberg, completed 1480 the choir, commenced by Hans von Minsgolsheim, of the Kilianskirche at Heilbronn, whence he was summoned 1492-4 to take down the piers of the tower to the cathedral at Ulm, which he replaced with larger ones. He quitted this work in 1502; but his name appears in the records of the Ulrichs and Atrakirche at Augsburg, 1473, as having restored the roof damaged by a storm; 1490, executed the choir vaulting of the Simperts-kapelle; 1499, vaulted the nave; and 1506, built the still unfinished tower. He died 1512; and at the entrance of the church is his gravestone with the epitaph, 'ein viel kunstreicher architektor der Statt Augspurg Werke und St. Ulrichs Gebäu Meister.' 68. 92.

ENG-GYENG. A useful wood of Amherst, but shaky; it is said to be used chiefly for posts only. 71.

ENGINEERING. The application of the mathematical laws of the resistance of materials, and of the motion of various bodies under the action of various forces, has given rise to a

subdivision of the duties of those entrusted with the execution of constructive operations, based upon the supposition that the class of investigations and studies connected with the above laws or of engineering requires a different mental constitution from the one which is more sensitively organized in matters connected with aesthetics, or the mental constitution required for an architect. Engineering itself is subdivided into several distinct classes, such as civil engineering and military engineering—names which sufficiently explain their respective purposes. Civil engineering, again, is subdivided into mechanical or general engineering; and the latter into either railway, road, hydraulic, mining, gas, or agricultural engineering, according to the nature of the work to be effected. The architect may in many cases find that his pursuits touch so very closely upon the limits of all those collateral structural branches of science, that he ought at least to be generally acquainted with their leading principles, if not with all their practical or technical details. Under any circumstances, it is absolutely necessary that the architect should be acquainted with the principles of physical science on which the various modifications of the art of engineering are founded. ARCHITECT; CIVIL ENGINEER. CRESY, *Encyc. of Civil Engineering*, 8vo., London, 1847; *History*, by RENNIE, given in *CIVIL ENGINEER Journal*, x, 50, 75, 113, 146; AIDE-MEMOIRE, etc., 8vo., London, 1845. G. R. B.

ENGLAND (WILLIAM OF), see JEAN D'ACRE (SAINT).

ENGLISH. The name proposed for POINTED ART, instead of GOTHIC, by the SOCIETY OF ANTIQUARIES, in *Some Account of the Cathedral Church of Durham*, fol., London, 1801, because "the nation assumed a new character about the time of Henry II. The language, properly called English, was then formed; and as architecture, founded on the Norman and Saxon, but extremely different from both, was invented by English artists, it surely is equally just and proper to distinguish this style by the honourable appellation of English." This reasoning has long been refuted, but the term remains in popular use chiefly because it was adopted by BRITTON, *Architectural Antiquities*, 4to., London, 1807, in his description of Malmesbury abbey church, whose nomenclature was English, 1189-1272; Decorated English, 1272-1461; Highly Decorated, or Florid, English, 1461-1509; Debased English, 1625. A similar phraseology was immediately employed in MILLERS, *Description, etc., of Ely*, 8vo., London, 1807, p. 16, whose limits were Early English, 1200-1300; Ornamented English, 1300-1460; and Florid English, 1460-1537. The same term has been employed by RICKMAN, *Attempt*, 8vo., London, 1819, as Early English, 1189-1307; Decorated English, 1307-1377; and Perpendicular English, 1377-1546: and by succeeding writers, as by SHARPE, *The Seven Periods of English Architecture*, 8vo., London, 1851, who, however, by an expansion of the term makes the following divisions and subdivisions: *Romanesque*—Saxon period, until 1066; Norman period, 1066-1145; *Gothic*—Transitional period, 1145-1190; Lancet period, 1190-1245; Geometrical period, 1245-1315; Curvilinear period, 1315-1360; and Rectilinear period, 1360-1550.

ENGLISH ARCHITECTURE. Although many portions of the history of art as applied to buildings in England have separately engaged the attention of authors, there is not, as yet, any general view of the whole subject superior to the articles in encyclopædias (which, fortunately, also supply notices of the variations of style immediately preceding the publication of those compilations): or that contained in the chapters allotted to the Fine Arts, in the PICTORIAL HISTORY OF ENGLAND, 8vo., London, 1836-40; or the attempt by ELMES, in the *CIVIL ENGINEER Journal*, x, 1847; or best of all, that in GWILT, *Encyclopædia*, 8vo., London, 1842, pp. 164-226. The course of architecture in England has been so far dissimilar from that which it pursued in other European countries as to warrant the assertion that its history has yet to be treated as it deserves.

The following list gives the terms under which the distinc-

tive periods, after the establishment of the Saxons, fall according to the plan of this Dictionary; and each of the appropriate articles indicates its own subdivisions, as well as the synonyms which have been suggested for it. The ROMANESQUE, prevalent until 1189 if not longer; TRANSITIONAL, about 1185-95; the EARLY ENGLISH, generally dated about 1190-1300, but past its transitional period at least before 1277; the DECORATED, generally dated about 1300-1375, but which was transitional 1350-1377, and not perhaps extinct in some districts till 1450; PERPENDICULAR, generally dated about 1375-1546, but occurring at least before 1352-1366 and culminating 1500-20, was employed for additions chiefly, in the phase known as TUDOR until 1630-40; REVIVAL, ELIZABETHAN, or JACOBÆAN, perhaps dating from about 1506, certainly from 1516, and which, fully established for small works before 1529, was only occasionally adopted for large buildings until 1546-49, and lasted until 1649; and ITALIAN, established 1619-20 by Inigo Jones, and continued by Sir C. Wren, who like Sir J. Vanbrugh and some of his rivals, was perhaps influenced by the French taste of their time: but the Rococo and the BAROQUE styles cannot be regarded as causing the increasing heaviness of Hawksmoor and Campbell, which culminated under James, Archer, and Gibbs; nor as inducing the return to a better condition which, due to studies of Italian works, was exemplified by Gibbs himself, by Kent, Leoni, Lord Burlington, Servandoni, Flitcroft, the Woods of Bath, the Dances, Vardy, the Brettingshams, the Paines, Carr of York, and Sir W. Chambers with his followers, Yenn, Gandon of Dublin, and Sir Robert Taylor. A remarkable contemporary criticism upon the English architecture of their period is expressed by BLONDEL, *Cours*, 8vo., Paris, 1771, iii, 422-3; especially in the words—"les peuple du Nord, qui ont cru imiter les productions de l'Antiquité, s'en sont encore beaucoup éloignés—l'Angleterre, nous osons l'avouer, est peut-être la seule qui ait suivi de plus près le bon genre des anciens." The Italian style modified by an appreciation of GRECIAN art, in the hands of Soane, Papworth, Joseph Gandy, and Holland (not to mention living architects), was the last expression of a general professional taste exhibiting proofs of individual feeling by the architects: yet the Italian style was strong enough to survive the Gothic fashion of 1730, the Greek taste introduced by Stuart 1755-62, the peculiarities of Adam 1760-64, and the revival of POINTED ARCHITECTURE, to say nothing of attempts at adapting CHINESE, INDIAN, EGYPTIAN, and MORESCUE art, or of the building for the Exhibition of Works of Industry of all Nations 1851 at London, and its progeny at Sydenham, 1854.

ENGLISH BOND (Fr. *appareil à assises alternatives, en queue, et en boutisse*). That arrangement of bricks, in a wall, by which the length of those in one course is perpendicular to the face of the work, while those of the next course have their length parallel to that face. This has been considered, since the publication of SAUNDERS, *Observations on Brick Bond as practised at various Periods*, 8vo., London, 1805, and reprinted in the *CIVIL ENGINEER Journal*, 1838, i, 329, as much stronger than Flemish work: but on the contrary, DEMPSEY, *Builder's Guide*, 8vo., London, 1851, p. 59-63, considers that if there be any difference in the difficulty of forming good bond, the superiority is not with the English fashion as commonly practised. The usual execution of fourteen-inch work in courses, or of eighteen-inch work as two nine-inch walls side by side without a central transverse tie, seriously modifies in practice the opinion expressed by HOSKING, *Building*, in the *ENCYCLOPÆDIA METROPOLITANA*, p. 76, that English bond affords a better transverse tie than the Flemish bond; and, indeed, good bricklayers, objecting strongly to English bond, avoid it. English bond went out of general employment about 1670 or 1680. It is understood that brickwork can be executed quicker in English, than in Flemish, bond. BOND; BRICK BOND; FLEMISH BOND; GARDEN WALL BOND.

ENGLISH or LONDON MANUFACTURE OF BRICK, see BRICK, p. 138.

ENGLISH HUT. The name for a large class of wooden cabins or huts rendered ornamental features by artistic skill. It differs from the COSSACK, the DUTCH, the POLISH, the RUSTIC, and the SWISS, hut, in consisting of square timber framed and bricknogged standing upon a brick or stone base. Specimens are given in KRAFFT, *Plans des plus beaux jardins*, fol., Paris, 1809, i, pl. 30, 34-5, 62, 82; and ii, 37.

ENGLISH PINK. A pigment which is a sort of DUTCH PINK, and like it, not to be mixed with white lead. 9.

ENGLISH RED, also called PRUSSIAN RED. The same pigment as VENETIAN RED or scarlet ochre. 9.

ENGOLISMA. A Latin name for ANGOULÊME in France.

ENGOUR, the ancient ANCYRA, see ANGORA in Asia Minor.

ENGRAILED or INGRAYED is used by HALL, *The Union*, etc., 4to., edit. 1548, fol. 73 of Henry VIII, in the sentence "a fountayne of enbowed woorke, gylte with fine golde, and bice, ingrayed with anticke woorkes." ENTAILED; ENTRAILED.

ENGUERRAND or INGELRAMME, is stated to have rebuilt 1214 the church of the abbey at Bec in Normandy, and to have directed the works done to the cathedral church at Rouen, in the beginning of the thirteenth century: WINKLES, *French Cathedrals*, 4to., London, 1837, p. 144. Another ENGUERRAND, surnamed 'le Riche', was commissioned 1338 to direct the continuation of the works to the cathedral church at Beauvais; WOILLEZ, *Cathédrale*, fol., Paris, 1831, p. 5. These are not to be confused with ANGRAND or ENGUERRAND, surnamed 'le Prince', who was employed in the same cathedral, but as a glass painter, and died 1530: WINKLES, p. 112.

ENNEASTYLE. The term adopted from the Greek language for a rank of nine columns or pillars facing the spectator.

ENRICHMENT. Another term for DECORATION.

ENSEMBLE. A French word now frequently used in England with reference to art. As regards architecture, it is employed in two senses. First in respect of the *entire design*, when the phrase 'the ensemble is good' means that the whole and its parts are consonant to, and in harmony with, each other; and secondly in the sense of *general effect*, as in the expression 'the ensemble is good, though some of the parts are defective'.

A. A.

ENSINGER or ENSINGER. The name of a family of artists which is supposed by WEYERMANN, *Neue Nachrichten*, 8vo., Ulm, 1829, p. 82, to have derived its appellation from Ensingen or Ensingen, near Freyburg (Fribourg), also in Switzerland; but by JAEGER, *Schwäbisches Stadtwesen*, 8vo., Stuttgart, 1831, p. 570, to have belonged to Berne; and NAGLER attributes to the talents of this family part of the church at Berne.

Ulrich, mentioned 1390 in a contract for five years, is the first in the list of *baumeisters* that appears in the records of the munster commenced 1377 at Ulm: he is supposed to have been the Ulrico da Frissengen di Ulm (not Feistingen as in JAEGER, nor Fillengen as in CICONARA, *Storia*, fol., Venice, 1813, i, 224), who was invited 16 July 1391 to assist in the works to the cathedral at Milan, but deferred his arrival to 12 April 1394 according to FRANCHETTI, *Storia*, 4to., Milan, 1821, p. 140: an account of the proceedings until the close of his engagement 13 April 1394 is given in GIULINI, *Memorie*, 4to., Milan, 1760, xi, 453-5. He seems to have been the *werkmeister* (1400, OTTE) 1420 at Strasburg, where the tower of the munster was the chief work in hand. The collegiats-kirche, commenced 1353, at Ueberlingen, at which the designer has not been recorded, and the Catherinen-kirche, begun 1370, at Esslingen, at which the builder is simply termed 'laicus', are attributed to the *baumeister* of the cathedral at Ulm, where the registers record the employment 1427 of Caspar 'steinmetz'; in 1429 he is mentioned as the son of the deceased Ulrich von Ensingen, who had two other sons, Matthæus and Matthias Ensinger.

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It is supposed that this cathedral owes great part of its beauty to that Matthæus, called in 1430 *kirchenmeister, werkman zu Bern un Uechllande*, whose name occurs in a document dated 1452 relating to this building, and who is consequently ranked by JAEGER amongst the six great mediæval architects of Germany: he was probably the designer of the tower, as his bust is on the winding stairs at the south side of that part of the edifice; and the Reithartische with the Rothische kapelle, the choir vault, and the sacristy, are also attributed to him. His death, generally placed in 1483, is recorded in an inscription, placed about 12 ft. from the ground at the north portal, which reads "Anno Domini mccccxliii do starb Matthæus Ensinger kirchenmeister dem Gott gnad." An old drawing, on parchment 10 ft. long, of the tower here named is given, to a small scale with part at full size, by MOLLER, *Denkmäler*, fol., Leipsic, pl. 57-8. A son of this Matthæus, called (1470) in the same records meister Mauricius Ensinger von Bern, contracted 1469 to complete the windows and the middle vaulting; he worked till 1480.

DIDRON, *Annales Arch.*, 4to., Paris, 1846, v, 92, states that the sacristy at Ulm possessed an interior elevation of the cathedral with the name of the architect, *Ensinger*, written upon it. 68.

ENSOR (GEORGE). The rotunda, adjoining the lying-in hospital in Dublin, was erected by Ensor. It is 80 ft. in diameter by 40 ft. in height; was built 1757 for a place of public entertainments; and in it have been held a large number of important public meetings. The walls are decorated with eighteen Corinthian pilasters, the intervals between which are occupied by windows having architraves and pediments. The ceiling is divided by concentric circles intersected by radii. Its acoustical properties are admirable. Some of the present decorations on the exterior of the building appear to have been added some years after by F. Johnston; a gallery was added in 1860; WHITELAW and WALSH, *Hist.*, 4to., Dublin, 1818. Merriion-square—"was laid out in 1762 by Ralph Ward, esq., and John Ensor" (not Enson) "the architect of Antrim house, on the north side of the square—the houses on the north side of the square are some of the best built and most convenient in Dublin: they were built after the design of Mr. Ensor"; WRIGHT, *Historical Guide*, 12mo., London, 1825, p. 141, 214.

ENTABLATURE (Sp. *entablamiento*; Fr. *entablement*; Ger. *gebälke*). This usually consists of three members termed the architrave, frieze, and cornice, though sometimes only of a frieze and cornice. The entablature is placed on columns or on pilasters, or it is used without the support of either, as on the walls of buildings, when it is termed a block entablature or CROWNING CORNICE (Fr. *entablement composé*). Sir W. CHAMBERS and VIGNOLA make it equal to one-fourth of the height of the column in each of the orders, while others employ different proportions according to the order used. PALLADIO, ALBERTI, and SCAMOZZI, made the entablature much lower in the Ionic, Composite, and Corinthian orders, than in the Tuscan or Doric orders: ancient examples of the same order differ, however, considerably in their proportions, as may be seen in NORMAND, *Parallèle*, fol., London, 1829, and MAUCH, *Neue System. Darstellung*, 4to., Potsdam, 1845. Sir W. CHAMBERS says, "it must be remembered that though the height of an entablature in a delicate order is made the same as in a massive one, yet it will not, either in reality or appearance, be equally heavy." Entablatures, used with or without columns or pilasters in interior decoration, have generally less depth given to them than when used externally. GWILT, *Observations on the Heights of Entablatures*, given in the *Transactions* of the Royal Inst. of British Architects, 4to., London, 1842, 123, shows a probability that the ancients may have proportioned their columns and entablatures on a principle of making the area of the entablature, taken on a geometrical elevation, equal to that of the columns, and the voids or intercolumniations equal to the amount of both; and the rules of

VITRUVIUS tend to the same point: but though this might sometimes occur, it would necessarily depend on, or limit, the intercolumniation; CIVIL ENGINEER *Journal*, 1842, v, 208. Details and a description of the construction of the entablature of the Parthenon and of the Theseum, supplied by METZGER to the *Allg. Bauzeitung*, 1837, p. 178-88, pl. 127-31, may be compared with those of the Parthenon contributed by SCOLES, *Certain Peculiarities*, read at the Royal Inst. of Brit. Architects 23 February 1846, and given in the *BUILDER Journal*, iv, 127. In BLONDEL, *Cours*, 8vo., Paris, 1771, ix, pl. 106 and 107, the construction of the pediment and entablature of the Louvre by means of iron bands is minutely shown. BARTHOLOMEW, *Specifications*, art. 595, shows a Roman method of forming and supporting a stone architrave projecting from the face of a wall; and MAZOUZ, *Ruines*, fol., Paris, 1824, the wood and stone construction of the entablature of the Forum at Pompeii. C. R. COCKERELL, R.A., *Description of the Temple to Jupiter Olympius at Agrigentum*, in the supplementary volume to STUART, *Antiq.*, fol., London, 1830, has illustrated the construction of the entablature at that temple. EPISTATON. A. H. M.

ENTAIL and ENTALLIATUS. The latter of these terms occurs in an item translated "To John le Rok, carpenter, working about a certain penthouse newly constructed over the stones 'entalliatas' for the chapel of S. Stephen", in an account of works done at the palace of Westminster 1319, according to BRAYLEY and BRITTON, *History*, 8vo., London, 1836, p. 121. The English word is found in the agreement 35 Henry VI, given in BRITTON, *Arch. Antiq.*, 4to., London, 1807-14, iv, 12, for a portion of the tomb of Richard earl of Warwick, wherein the marbler covenants to do "all the work and workmanship about the said tombe to the entail, according to the pourtraicture delivered to him"—but the entail was to be at the charge of the executors. It must be held erroneous to suppose that these terms are in any way obtained from ENGRAILED or ENTRAILED. On the contrary the word, evidently the It. *intagliato*, Fr. *entailé*, might signify either that the device was cut into the ground as a preparation for filling in with enamel or glass or other mosaic work: or more probably that the ground was cut away, leaving the device on the original face of the work in a sort of relief; or any masonry *sunk on the face* might have been called entailed, such as the shallow surface panelling which so discreditably distinguishes late mediæval work, especially in England. But as "setting apart superfluity of too great curious works of entaille and busy mouldinge" is a phrase relating to King's College chapel at Cambridge, in the will of king Henry VI; which also contains a similar passage with relation to the college at Eton (NICHOLS, *Collection*, 4to., London, 1780, pp. 296 and 303); and as SPENSER, *Faery Queene*, 4to., London, 1590, says, 2, vii, 4, 'a worke of riche entayle and curious mould, woven with antickes and wild ymagery'—2, iii, 27, 'entayld with curious antickes'—and 2, vi, 29, 'the mortal steele despiteously entayld deepe in their flesh', it may be concluded that this term was used for carving in general; as would also appear from CAVENDISH, *Life of Wolsey*, 8vo., London, 1825, i, 233, 'most lively entaylled—entaylled images'; although LYDGATE, *Boccace*, xlv, speaks of 'ymages curiously carve out by entayle', and CHAUCER, *Rom. R.*, cxvi, mentions 'an image of an other entaille'.

ENTASIS (Gr. *ἐντάσις*, derived from *ἐντάσσω*, I interpose). This term, corresponding to 'the adjectio' of VITRUVIUS (It. *agginta*; Fr. *renflement*), has been adopted in the English language to express the increment or exaggeration of outline necessary to correct that optical illusion which produces an apparent hollowiness in an extended straight line; and this entasis should never be so exaggerated as to be perceptible in itself, but simply sufficient to compensate for the above illusion; the existence of such an increment in the columns of Greek buildings was only first noticed 1814 by Allason, and confirmed by the measurements taken by Cockerell and Haller. Although described by PENROSE, *Investigation*, fol., London,

1851, p. 39, as the "well known increment or swelling given to a column in the middle part of the shaft for the purpose of correcting a disagreeable optical illusion which is found to give an attenuated appearance to columns formed with straight sides, and to cause their outlines to seem concave instead of straight"; entasis, according to the same author, p. 79, "appears to have been applied by the Greeks to these and other lines liable to appear distorted; for example, the inclined lines of the pediments of the Theseum are slightly convex"; and VITRUVIUS, iii, 3, shows that entasis was not confined to the correction of a seeming deflection in the shafts, but was applied to other lines subject to similar effects. He says "the stylobate should be so adjusted as to have in the middle an addition by means of varying slight ascents (literally varying little steps), for if it be made level it will appear somewhat hollowed. Afterwards he notices the finished capitals placed on the shafts of the columns, not to a level line, but to an adjusted measure; so that whatever should have been the amount of entasis made at the stylobate, there might be a symmetrical conformity in the upper members: this subject has been discussed in various papers in the *BUILDER Journal*, 1846, iv, 122, 151, 187, and in the *CIVIL ENGINEER Journal*, 1846, ix, 98, where PENROSE, considering the curve of the entasis in the columns of the Propylæum and of the Parthenon to be hyperbolic, has given a means of setting out such curves.

The mediæval architects also occasionally used an entasis. The round towers, excepting those of a late date, in Suffolk (*BUILDER Journal*, xvi, 260) have an entasis; and a diminution and entasis are common features in the towers of Essex and Middlesex. The tower of All Saints church, Colchester, has an entasis, and diminishes from 22 ft. to 19 ft. with internal offsets. This expedient was also employed, sometimes in excess, in spires and broaches, as may be seen in the spires to the west end of the cathedral at Lichfield; the spire of Gedding church (*CIVIL ENGINEER Journal*, vii, 47, 105), about four miles from Nottingham, has an entasis which in its widest part is not less than 2 ft.; and the spire at Newark, of about the same date, affords an instance of a curved line: but in most cases of mediæval spires the effect was not produced by a continuous curve, but by distinct lines; the fragment at the church of S. Mary Redcliff at Bristol may be cited as showing two distinct lines in even so small a part of the work: where the required form is given in three lines, the junctions generally occur at one-third and two-thirds of the height; one of the spires at Stamford has an outline formed by only two lines and one angle in the height. A rule for regulating the entasis of a spire is described by T. TURNER, *BUILDER Journal*, 1848, vi, 375.

In the supplementary volume to STUART, fol., Lond., 1830, W. Jenkins says with regard to the entasis of columns, that it "escaped the exact and minute attention of Stuart and Revett; yet of its importance no one will doubt, who considers but for a moment, how much of beauty depends upon the nicely executed contour of the shaft of the column.—Vitruvius, in noticing the diminution of columns, is very concise, and has evidently laid down rules rather coinciding with his own ideas of their fitness, than with the precedents in Grecian architecture, which elsewhere he affects to take as his guide; for the examples which are here given" (i.e. from the portico of the Propylæa and from its north wing, the temple to Theseus, the Parthenon, the monument to Lysicrates, the northern and the eastern porticoes of the Erechtheum, at Athens; and from the peristyle and pronaos of the temple to Jupiter Panhellenius at Ægina) "do not illustrate his rules.—The entasis in every instance here given is produced from the bottom of the column, but none has the entasis perceptible to the eye, and scarcely to the rule, so slight is it: from which we cannot but infer, that it never was the intention of the Grecian architects to produce any other effect to the eye of the beholder than that of a straight line; nor are we aware that there is any example now remaining which is an exception, but the columns of the pseudo-

ENTRANCE - GATE



Porta Romana PERUGIA F.P. Cockerell



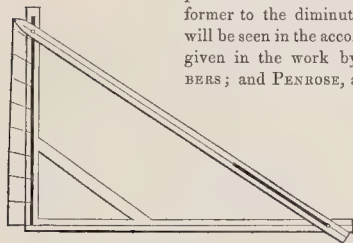
ARCO DI AUGUSTO, PERUGIA F.P. Cockerell
(The Bohemian modern)

Lithographed for the Society by F. Bodford June 30th 1859



dipteral temple at Pæstum", where indeed that temple offers the singular antique example of the effect produced by an exaggerated entasis: an effect which has been carried into caricature by those modern architects who have failed to perceive the merits and defects of the rules laid down by the Italian masters: the systems of Serlio, Cipriani, Vannini, Barozzi, Rusconi, and Scamozzi, are given with one of his own, by MARINI, *Vitruvius*, fol., Rome, 1836, iv, pl. 29. PENROSE, however, states, p. 81, that the amount of entasis as employed by the Athenians depended in some degree on the absolute height, for it is relatively less in small than in large columns. WILKINS, i, p. 39, says if the width of the fillet between the flutings of columns be the standard of the entasis of VITRUVIUS, the deviation from a straight line will be scarcely perceptible in the outline of a column. As first observed by BLONDEL, *Traité des quatre principaux problèmes*, fol., Paris, 1673, an old and good curve of diminution is Nicomedes's first conchoid. The conchoidal curves are constructed by drawing from a point any number of right lines cutting another right line, and setting off from the latter outward or inward on the former any distance, when a line drawn through the points found gives the curve. Outside the curve is a first, and inside a second conchoid. The

practical mechanical application of the former to the diminution of a column will be seen in the accompanying figure, given in the work by Sir W. CHAMBERS; and PENROSE, after inventing a modification of this instrument which is said to draw the hyperbola with great exactness, as described in the *BUILDER*



Journal, 1850, viii, 291, has called attention in the *CIVIL ENGINEER Journal*, 1850, xiii, 161, and *ARCHITECT Journal*, 1850, ii, 172, to another instrument for the same purpose invented by JOPLING, for describing the entasis of columns by a very flat ellipse. In determining the entasis to be given to a column or to the several lines of a building, attention should be paid to the influence which the surrounding curved, and other, lines may exert by themselves creating OPTICAL ILLUSIONS which might neutralize the effect of the proposed entasis by comparison. DIMINUTION. A. H. M.

ENTERCLOSE, ENTERCLOSE WALLS, ENTERCLOYSS WALLS, ENTERCLOSE WALLIS. This term is used by WYRCESTEER, *Itin.*, 8vo., Cambridge, 1778, p. 288, "Et le enterclose per quam vadit a porta ad aulam (of Woke) est longitudinis secundum estimationem dimidium furlong, et archuata cum lapidibus pendentibus desuper plano opere." It also occurs in the account rolls of the priory of Finchale, published by the SURTEES SOCIETY, 8vo., Newcastle, 1837, cclxxi, "Et in emendacione diversorum caminorum luteorum, arearum, lez enterclose wallis tenementorum in Balio"; cclxxxii, "pro nova construccione ejusdem tenementi cum factura lez entercloyss walls et unius loft ejusdem tenementi"; and ccxcviii, "pro dalbura murorum caminorum et enterclose wallis": in which three cases the term has been considered to mean walls of partition between one house and another; but this explanation does not seem to apply to the first passage above quoted, where it has been supposed to mean a passage, between two rooms in a house, or leading from the door to the hall.

ENTER-GIRDER and ENTER-JOIST. The terms by which PRICKE, *The Art of Fair Building*, fol., London, 1670, p. 16 in four places, and p. 26 in three places, translates the word 'entresole' in LE MUET, *Maniere de bastir*, fol., Paris, 1623, p. 34 and 57.

ENTRAIL or ENTRAYLE. This word is evidently not connected, through 'entail', with the Fr. *entailé*, but as ap- ARCH. PUB. SOC.

pears from SPENSER, *Faerie Queene*, 1590, i, i, 16; 2, iii, 27; v, 29; xii, 61; and 3, vi, 44; xi, 46; it may have some affinity with *entrelacs*, which was the French term for the fillets or listels and foliage or fleurons, binding and crossing among themselves, which were not only the ornaments for moldings and friezes from the commencement of the sixteenth century, but soon became on a larger scale the fashionable decoration of galleries, balconies, staircases, etc. The GLOSSARY, s. v. Arabesque, stating that a kind of ornament which may be called arabesque was much used in the domestic architecture of this country in the sixteenth and seventeenth centuries, is frequent



in monuments of the same period, particularly of the time of James I, and seems to have been termed in French *manequinage*, adds that it is probably what HALL, *The Union*, etc., 4to., 1548,

terms "ancient Romayne woork" or "entrayled worke", 12 Henry VIII; and "vinettes and trailes of sauge worke", 19 Henry VIII. ENGRAIL; ENTAIL. 5.

ENTRANCE (It. *entrata*; Sp. *entrada*; Fr. *entrée*; Ger. *eingang*). The door or gate, and its decorations, by which access is obtained to a property or separated part of a property. The term, however, has been used very improperly instead of approach, when speaking of an avenue or a road, either of which may be the approach to the entrance gate of a town or the entry of a house, but never the entrance or entry itself. GATE, HALL, STEP, TOWER, etc.

ENTRESOL. A French word, which has been Anglicized 'entersole', and which originally meant a room or rooms obtained over others in the general height of any story: it thus corresponded to one sense of the It. *mezzanino*, and to the Sp. *entresuela*; but it became applied, as did *mezzanino*, to a story of low rooms between any two principal floors: in fact mezzanine at present is used in England for either of the above conditions, as well as for that under which entresol is now chiefly employed in France, viz. for a story of little height between the ground floor (to which indeed it properly belongs, and of which it generally forms a portion externally) and the story which is usually called the first floor, though this principal story becomes literally a second floor. 5. 19.

ENTRY. The technical appellation of a covered way from the outermost door of a property to the door of the dwelling: thus an enclosed porch with outer and inner doors is as properly an entry as the passage, through a building, into which the doors of separate habitations or offices may open; or a passage, through any edifice, into an inner court.

EOSANDER, Freiherr von Göthe (JOHANN FRIEDRICH), was a native of Sweden, but went about 1692 to Berlin, where he studied so successfully that the expense of his tour in Italy and France was defrayed by the elector Frederic, afterwards king of Prussia. On his return 1699 to Berlin, he was made *hauptmann* and *baumeister*, and was not only commissioned to plan a portion of the city, but to decorate the opera house, and in 1701 to superintend the decorations, etc., during the coronation at Königsberg. Soon after that event he was promoted to the rank of *generalquartiermeister-lieutenant* and chief *baudirektor*. In 1704 he commenced the *schloss* at Schoenhausen, and became 1705 *oberst* and *generalquartiermeister*. He next built both wings of the *schloss* at Charlottenburg, and placed, on the main building designed by Schlüter, the cupola. He 1709-12 began the great orangerie-saal there; and erected 1706-9 the residence called 'Favorite', and the orangerie at Oranienburg; about the same time the chief part of the little palace in the garden called Monbijou, given by Frederic I. to the countess of Wartenberg 1708, was designed by Eosander and completed before 1710, when it was sold to the king, who enlarged it; and it was again enlarged 1790. In 1709 he built the *schloss*, burnt about 1770, at Altlandsberg for the herr von Schwerin. Upon the disgrace of Schlüter, which was attributed to Eosander, the latter was entrusted 16 February 1707 with

the direction of the palace at Berlin, to which he added the (west) side next the Freiheit with the great *portale*, and the western end (projecting five feet) of the north front towards the Lustgarten, the two staircases resting upon columns, and the three sides of the inner court of the schloss. This edifice was not completed by him, but in 1716 by Böhme, as Frederick William I, at his accession in 1713, considered that Eosander was too highly paid; the latter thereon obtained 1714 the rank of *generalmajor* in the army of Charles XII of Sweden, to whom he had been sent (1704 and 1712) as ambassador, and by whom he was employed in the defence of Stralsund, where he became 1715 a prisoner of war to the Prussians, and whence he retired on parole to Frankfort-on-the-Maine, where his wife (of the Merian family) had property invested in the publishing house of that name. Here he published the *Kriegsschule*; but having ruined the firm by his domestic extravagance and alchemical pursuits, he obtained 1723 the post of general-lieutenant in the Saxon service, and died 1729 at Dresden, according to the very full memoir in the *Nachricht*, p. 86, appendix to NICOLAI, *Beschreibung*, 8vo., Dresden, 1786.

EPHEUA FALCATA, *Wallaba*. A tree of British Guiana, bordering the river Essequibo. The wood is of a bright red-brown colour, hard, and heavy, splits freely, and is very durable, being impregnated with a resinous oil. It is used for house frames, palings, shingles, staves, etc. A roof well shingled with this wood will last upwards of forty years. It may be had from 15 to 20 ins. square, and from 30 to 40 ft. long. 71.

EPHEBEUM (Gr. ἐφηβείον, from ἐφηβος, a youth). The place where the young men exercised in the palaestra; VITRUVIUS, v, 11. *Detached Essay*, BATHS, etc., p. 8. A. A.

It comprised amongst other appurtenances, the sphæristerium and the corycæum: these last are supposed to have been situated, at the thermæ of Caracalla, around (the ephebeum) the cloistered court in each wing.

EPHESIAN RED, see MINIUM.

EPHESUS. One of the many names of a city situated on the river Cayster in Lydia. Being the port of Ionia, it was the mart of commerce between Greece, Egypt, and Persia, until its destruction by the Goths of Bosphorus, A.D. 262. The present article is indebted to the prospectus of a projected work by E. FALKENER, *Ephesus and the Temple of Diana*, for the following notes; viz. that the chief points of interest were the two ports, the agoras, five or more gymnasiums, the theatre, and the odeium; besides the temples and porticoes, the city walls and gates, the aqueducts and fountains, and the tombs. This author proposed to establish that the celebrated temple to Diana always occupied the same locality, but not always the same site; that seven earlier temples preceded the last one; and that with regard to this, the statements to be credited are that it had a decastyle and eustyle peristyle of one hundred and twenty columns showing nineteen pillars on each flank; that the columns (not monolithic) were of an Ionic order, and eight and a quarter diameters in height; that the temple was surrounded on the outside with statues; and that amongst the appendages to the temple were the portico of Damianus, the banqueting hall, and the temple to Hecate. From other sources it appears that the last temple, built by Deinocrates after the fire B.C. 356 and nearly completed B.C. 334, was the largest of such Greek works, though in the time of Herodotus the existing temple was exceeded in this respect by the Heræum at Samos; that it succeeded to one built by Ctesiphon and Metagenes about B.C. 560, which was enlarged and completed by Demetrius and Peonius about B.C. 380, and burnt by Herostratus; and that Theodorus and Rhæcus had been the architects of the first of these temples, built about B.C. 600 by the Ionians at Ephesus: VITRUVIUS, iii, 2, states that the temple by Ctesiphon was dipteral and of an Ionic order; the rest of his statement is susceptible of several meanings. PLINY, *H. N.*, xxxvi, 21, specifies that the last temple was 425 ft. long and 220 ft. wide, with columns 60 ft. high of eight diameters

in height; and in the remarkable passage "in solo id palustri fecere ne terræ motus sentiret aut hiatus timeret: rursus ne in lubrico atque instabili fundamenta tante molis locarentur calcatis ea substravere carbonibus dein velleribus lanæ", accounts for the lowness of its situation. He further mentions the columns as one hundred and twenty-seven in number, of which thirty-six were enriched: according to DALLAWAY, *Constantinople*, 4to., London, 1797, p. 217, eight of its columns are placed on the north and south sides of the dome of Sta. Sophia in Constantinople, and two others in the cathedral at Pisa, but this would seem to be an error, as CODINUS (the only authority upon the subject) does not specify the portion of the locality from which the eight shafts in question were taken. LEAKE supposes the temple to have had the arrangement of a dipteral decastylar temple, but with three rows of ten columns in front instead of two; thus with twenty-one (twice as many as in front and one over) at the sides, with four in antis at each end, would make one hundred and twenty-eight. Medals showing the shrine are given in DONALDSON, *Arch. Num.*, 8vo., London, 1859, fig. 6, from which that author considers that the theory of a decastyle temple may be confuted. The disappearance of the temple is noticed by CHANDLER, *Travels in Asia Minor*, 4to., Oxford, 1775, p. 124, who mentions the remains of a theatre which, according to the dimensions taken by C. R. Cockerell, and given in LEAKE, *Tour in Asia Minor*, 8vo., London, 1824, p. 328, was the largest known to remain, being 660 ft. wide on the outside, with 240 ft. of internal clear diameter; the odeium; a stadium about 687 ft. long, supported on one side by arches, which ПОКОЧЕ, *Description of the East*, fol., London, 1745, 2, ii, 46, observed had curved walls across it near the rounded end; and a Roman temple about 130 ft. long by 80 ft. wide, of a Corinthian order, "that was in antis or of the eustyle species", and had four columns between the antæ, the columns being fluted, monolithic, and about 47 ft. in height. Some of the details of this last building are given by the SOCIETY OF DILETTANTI, *Ionian Antiquities*, fol., London, 1797, ii, pl. 44-5, as well as of a gymnasium with its plan, pl. 39-43. WHEELER, *Travels*, fol., London, 1682, p. 254, noticed the still existing fine aqueduct with two ranges of arches and an inscription in honour of Tiberius, about five or six miles from Ayasalouk (the modern Ephesus) on the road to Scala Nova. HAMILTON, *Researches*, 8vo., London, 1842, also discusses the site of the great temple, and praises the well-built wall (including a particular gateway which he illustrates) carried by Lysimachus B.C. 320 along the hill Coressus. A plan of the city was published by KIEPERT; a very conjectural restoration of the chief structure by HIRT, *Tempel der Diana von Ephesus*, 4to., Berlin, 1809, appears less worthy of notice than the suggestions made by WILKINS, *Antiquities of Magna Græcia*, fol., Cambridge, 1807, p. xviii.

EPICAUSTERIUM. A term used by ORDERICUS VITALIS, which is usually explained as a room where princes and their chief officers, reclining on couches, enjoyed the perfumes of burnt herbs, aromatics, etc.

EPICRANITIS or EPIKRANITIS (Gr. ἐπικρανίτις). The term in the inscription given in WILKINS, *Profusiones*, 4to., London, 1837, p. 55, for (each separate stone of) the sima of the cornice of a pediment; INWOOD, *Erechtheion*, fol., London, 1827, p. 94-5.

EPIDAURUS. A town, formerly, in Argolis in Peloponnesus. It was celebrated for a temple to Æsculapius, situated between four and five miles from it; and the town, placed on a recess of the Saronic Gulf; had sunk to the condition of the port to the temple before the image of the deity was removed to Rome. PAUSANIAS, iii, 100, describing the objects which were contained within the *hieron* or sacred enclosure, asks "for beauty and harmony of proportion who can compare with Polyeletes, who was the architect of the theatre and of the *tholos*" (i. e. about B.C. 320?) and mentions the stadium formed by an embankment. The place was described by LEAKE, *Travels*

in the Morea, 8vo., Lond., 1830, ii, 423, who says that the theatre was in better preservation than any other in Greece except that at Dramyssa; that it still showed thirty-two rows of seats in the division below the diazoma, above which were twenty ranges; that the orchestra was about 90 ft. in length; and that the entire theatre, being about 370 ft. in diameter, would hold twelve thousand persons. This account, which is accompanied by a notice of the circular end and a part of the adjacent sides of the stadium showing fifteen rows of seats, and the intimation of two reservoirs, a bath, and the supposed foundation (20 ft. in diameter) of the *tholos*, differs in several respects from the conclusions drawn by DONALDSON, *On the Form, etc., of the Greek Theatre*, in STUART, *Antiq. of Athens*, supp. vol., fol., London, 1830, explaining the two plates of his illustrations of the theatre and of one reservoir. Neither of these writers, moreover, appears to be confirmed entirely by the illustrations in BLOUET, *Exped. Sc. de Morée*, fol., Paris, 1836, ii, 163, who gives, pl. 76-7, a general plan and a section of the site; pl. 78-9, a plan and section of the theatre; pl. 80, a plan of the stadium; pl. 81-3, several details, inclusive of two shafts of a Doric order with twenty-four flutes, shallow in one example, but semicircular in the others; pl. 84, the two reservoirs with details of one of the conduits; and pl. 85, a general view of the place.

EPINE (. . . DE L'), see LESPINE (. . . DE).

EPISCENIUM and EPISCENOS. These two words, used with the same meaning in VITRUVIUS, vii, 5, and v, 7, and obtained by him through the Gr. ἐπισκήμιον and ἐπίσκηνος, from ἐπί 'upon', and σκηνή 'the scene or back of the stage' in a theatre, evidently mean the pictorial or structural decoration raised upon the podium or real scene; thus, in describing a scene having three tiers of columns upon the podium, he uses for the uppermost one the expression 'tertia episcenos': so that the usual translation 'on or above the stage' is likely to mislead.

EPISCOPAL CHAPEL. The name given in five distinct cases: 1, it is indiscriminately applied to all places of worship, not being churches, belonging to the Anglican Church: 2, to the places of worship belonging to the members of the Anglican Church in Scotland, where such buildings fall under the provisions of the Acts of Parliament 10 Anne, c. 7, 14 George II, c. 38, and 21 George II, c. 34: 3, to what is sometimes, improperly, called a chapel of ease, but is really a private or proprietary chapel not necessarily consecrated, and which, when the license from the bishop to the officiating clergyman is wanting, may be converted to any secular use. This is the technical definition of an episcopal chapel; but it is not without some vagueness as, 4, the same words seem to be the legitimate title of a chapel founded by a bishop on ground that is quite or nearly freehold, for the convenience of an extrapara-chial or a crowded district; which fourth use of the name may have arisen from its being considered a bishop's private chapel: and 5, the title is given to the domestic chapel attached to the residence of a bishop. With regard to such structures, it is urged in the *Ecclesiologist Journal*, 1845, iv, 146, that they should bear considerable affinity to college chapels which, being for the sole use of a religious body, are all choir, the nave being reduced to the functions and dimensions of a mere ante-chapel; and that, while accommodation is provided for the lay members of the household in the nave, ample room should be afforded in the stalls for the bishop and his clerks. A description of the private chapel of archbishop Laud is given in PRYNNE, *Canterburie's Doome*, fol., London, 1646.

EPISCOPAL PALACE. The term palace has been applied in England since 1688 to the official residence of a bishop or of an archbishop. The usual requirements at the present day are simply those of the mansion of a nobleman of corresponding rank and wealth; and it is not necessary to mention here more than references to a few of the remains of mediæval subjects of this class. The original palace at WELLS, supposed to have been erected for Savaricus Barlowinwac, 1192-1205,

with the chapel attributed to Joceline of Wells, 1206-42, and the great hall 112 ft. long by 58 ft. wide, that may have been built for Robert Burnel, 1275-92, are described by DAVIS, in the *Journal of the Archaeological Association*, 1857, xiii, 178. The remains of the palace at S. DAVID'S, built for Henry de Gower, 1328-47, and considered to be almost unsurpassed in England, are given in NORRIS, *Arch. Antiquities*, fol., London, 1810. That at ELY has its best part dating in the time of John Alcock, bishop 1486-1500.

In France the palace at Evreux, given in TAYLOR and NODIER, *Voy. Pitt.* (Normandie), fol., Paris, 1820, pl. 225; that at Arles, built 1388-91 for François de Conzié, may be noticed, as well as the illustration of that at Paris, as it existed a fortified building in the fifteenth century, by LASSUS and VIOLET LE DUC, *Rapport sur les réparations à faire à l'église Notre Dame*, 4to., Paris, 1843. The palace at Liège, illustrated by VAN KAMPEN, *Vues, etc.*, rebuilt 1505-37, and restored after a great fire 1734 by Annesens of Brussels, is given in the *ALLGEMEINE BAUZEITUNG*, 1853, pl. 597-600, as rearranged and repaired by Delsaux to serve as the residence and offices for the government officials. The episcopal palace at Siena, a work belonging to the fourteenth century, is said to deserve illustration.

EPISCOPIUM. The late Latin term for an episcopal palace, and not for a campanile, although so translated by some authors, as by D. HENRIQUE FLOREZ from D. LUCAS DE TUY, writing about the episcopium at Orense erected 1226-52.

EPISTATON (Gr. ἐπίστατον). This term, in the plural *epistata*, is explained as 'synonymous with the *epithemata* of PAUSANIAS, which alludes to the whole of the superstructure above the columns of a portico', by WILKINS, *Prolusiones*, 4to., London, 1837, p. 59, who notices that the Septuagint uses the word *epithemata* in the same signification, and adds that *epistata* alludes to the three members of an entablature. EPISTYLIUM; EPITHEMA.

EPISTLE SIDE OF A CHURCH. The right hand side of a person looking from the nave to the chancel; where orientation has been observed, this is the south side of the church, but even in some such churches it is the exceptional practice to read the Epistle from the north side of the Communion Table.

EPISTYLIUM (Gr. ἐπί, upon, and στῦλος, a pillar). A Latin term which was obtained by VITRUVIUS from the Gr. ἐπιστύλιον, that seems only to have been used by PLUTARCH, in v. *Pericles*, xiii; and in both authors it means the ARCHITRAVE, i. e. that part of an entablature immediately on the tops of the columns, although in the old Dictionaries 'chapter of a pillar' is the translation given. EPISTATON; EPITHEMA.

EPITHEMA (Gr. ἐπίθεμα and ἐπίθημα). The name given by HOMER, *Iliad*, xxiv, 228, to a cover such as the lid of a chest; and in SMITH, *Dict. Ant.*, s. v. *funus*, the word is stated to mean the oval head of a stela or upright stone tablet; this explanation being accompanied by a notice that among the Sicyonians the head took the form of a pediment. This statement depends upon the amount of authority (not there given) for the existence of any such technical name for the cover of a cippus or of a sepulchral urn, and upon the rendering given to the passage in PAUSANIAS to which reference is made by WILKINS, *Prolusiones*, 4to., London, 1837, p. 113, who says that although the vulgate version translates the term *epithemata* by the well known word *epistylia* in 2 CHRONICLES, iv, 12, i. e. 'hoc est columnas duas et epistylia et capita', the word has a much wider signification, and means not only the whole entablature, but the pediment of a building. In this sense, he thinks, it is used by PAUSANIAS, ii, 7, who, in speaking of the Sicyonians, observes that, in their construction of a sepulchral memorial, they made a stone base on which they raised columns, and completed the work by placing upon these pillars a pediment resembling the gable (ἀέτος) of a temple: a design rather differing in detail than in spirit from such a pediment is suggested by DONALDSON, *On the Form, etc., of the Greek Theatre*,

in STUART, *Antiq. of Athens*, supp. vol., fol., London, 1830, where he gives an appropriate employment of this sort to a fragment found at Epidaurus. WILKINS adds that the common meaning of the word *epithema* is *operculum*, a lid or cover; that it is used in a more extensive signification by the commentators, who explain it as inclusive of the capital and entablature; and that it has been translated by *coronamentum* and *corona*. But these explanations by no means suit the views expressed by WILKINS, pp. 114-6, where some term like 'finial' would at once convey such an idea as that exhibited by the tee of a DAGOBA, and would suit the literal translation of passages in PAUSANIAS, i, 2; vii, 2 and 17; viii, 15; and ix, 40. EPISTANTON; EPISTYLUM.

EPITITHIDES. This term is used by VITRUVIUS, iii, 3, in the passage "above the coronæ the simæ, which the Greeks call *ἐπιτίθιδας*, are to be made", etc. It is derived probably from *ἐπιτίθημι* (I place upon, or above, anything), as they are the highest of all the members of an order.

A. A.

EQUILATERAL ARCH. A pointed arch consisting of segments of a circle, the curves being described from centres taken at each end of the base of an equilateral triangle, at the apex of which they consequently intersect. A very curious example in the porch of the church of S. Mary at Devizes has five ranges of chevron molding outside it; and the nave arches of the cathedral at Salisbury are likewise noteworthy. 19.

EQUILIBRIUM OF AN ARCH. An arch is said to be in equilibrium when the various forces brought into play by its construction and ultimate use balance each other.

Considerable space has been devoted to scattered contributions upon this subject in the scientific periodicals; among these may be noticed the formulæ and calculations given in the *BUILDER Journal*, 1844, ii, 37-49, 61, 47, 109; 1846, iv, 508, 519, 619; and BARLOW, *Construction of Arches*, in the *CIVIL ENGINEER Journal*, 1847, x, 211, 249; which also, 1848, xi, 132, gives SNELL, *Stability of Arches*, referring to MOSELEY in the *Transactions of the CAMBRIDGE PHILOSOPHICAL SOCIETY*, 4to., Cambridge, 1835, v, 293, 1836, vi, 463; and in his *Mechanical Principles of Civil Engineering and Architecture*, 8vo., London, 1843. The *Transactions* of some of the scientific bodies also contain papers of importance, amongst which are those of RENNIE, *Expansion of Arches*, of BARLOW, and of SNELL, above named, in the Minutes of the Institution of Civil Engineers, 1842, iii, 201, and 1846, v, 162 and 439. The latter does not hesitate to say that all the theories previous to that of Professor MOSELEY are useless: but in the same portion it allows that the old problems sufficiently answered the purpose for bridges until railway trains had to be carried, and this admission involves the inference that the old theories might have equally answered in cases of simple vaulting: the paper cited, moreover, asserts that such preceding theories "are quite useless in determining the stability of vaults on high walls; there is not, perhaps, a single vaulted roof now standing, that does not prove their fallacy." In consequence of the dissemination of the statement that pointed arches are stronger than those which are semicircular, it is thought worth while to notice, among those old theories, one which does not appear to have obtained popular favour, but which is worth examination, viz. that propounded by YOUNG, *Origin and Theory of the Gothic Arch*, in the *Transactions of the Royal Irish Academy*, 4to., Dublin, 1790, iii. This author considers that with regard to an arch carrying a wall, "it may seem reasonable to conclude that portions of circles are in all cases preferable to semi-elliptic arches, or those curves of many centres, which of late have become so fashionable in the construction of bridges: and the strength of a semi-ellipse of the same span and altitude is to the strength of the curve used in the bridge of Neuilly as five to four."

In considering the equilibrium of arches, it will be obvious that a material and important difference occurs between those arches which like vaulting are simply required to cover a given

space and balance themselves; those arches which like domes are weighted upon the crown; and those which in the case of bridges are destined to carry rolling weights, such as railway trains or heavy carriages. In each of these instances the construction of the arch, its voussoirs, abutments, and haunches, must be so designed and proportioned under all the circumstances to which they are exposed as to maintain their form, or in other words, their equilibrium; but as these circumstances differ much in every instance, they are points to which no rule can be applied, but which must be left solely to the judgment of the architect or engineer. It is also obvious that the various strains to which an arch is exposed will vary in character and intensity with its form, whether pointed or round, segmental, elliptical, flat, or deep. The strongest arches will, however, from the simplicity and unity or homogeneity of the forces in action, invariably be those which are described from one centre, like the semicircle and segments, as distinguished from the pointed and the elliptic.

The elliptic arch as usually constructed from several centres is condemned by HASKOLL, *Assistant Engineers' Railway Guide*, 8vo., London, 1848, pt. ii, 148-9, as being weaker than a segmental arch, and requiring for equal spans greater depth of arch and thicker piers: he allows the use of pseudo-elliptic arches up to 20 ft. span with three centres, but requires five centres for larger spans.

The assertion made by HOOKE that the inversion of the figure into which a chain or rope that is perfectly flexible will arrange itself when suspended from two points is the proper form for an arch composed of stones of uniform weight, is stated by ROBISON, in the *ENCYCLOPÆDIA BRITANNICA*, 1797, s. v. *Arch.*, to be a principle strictly just, and fit for every case which can be proposed; while the theory founded upon it aims at such an adjustment of the position of the arch stones to the load on every part of the arch, that all shall remain in *equilibrio*, although the joints be perfectly polished and without any cement. Then speaking of the catenarian curve as commonly said to be the best form for an arch, this author observes that although it is the only form for an arch consisting of stones of equal weight, and touching each other only in single points, it cannot suit a bridge, but would only be proper for an arcade carrying a height of dead wall. The same authority adds that although volumes have been written on this celebrated theory of the equilibrium of arches, one of the most delicate and important applications of mathematical science, and although it still occupies the attention of mechanicians, the speculations of the eminent persons who have prosecuted this theory "have been of little service, and are little attended to by the practitioner": he then adverts to the general facts which occur in the failure of arches, affirms that a great number of these facts are irreconcilable to the theory, and considers the theory not erroneous, but defective in consequence of leaving out the circumstances of construction. It should be added that ROBISON pronounces the pointed arch to be very strong, and a dome convex to the interior to be stronger than one convex to the exterior.

GWILT, *Encyc.*, § 1351-62, says that in this country, the equilibration of the arch, as given by BELDOR and others on the continent, seems to have prevailed: EMERSON, *Treatise*, 1743, appears to have been the first who thought, after HOOKE and GREGORY, of investigating the form of the extrados from the nature of the curve; in which he was followed by HUTTON, who added nothing to the stock of knowledge, an accusation admitted against himself by GWILT, who confesses that, for the practical architect, "no theory wherein the extrados is merely made to depend on the form of the intrados can ever be satisfactory or useful": and Sir JOHN RENNIE (*BUILDER Journal*, 1847, v, 29) is reported to have said that "a proper theory of the equilibrated arch which shall satisfy all the conditions of the question, when applied to practice, may be said to be still wanting, although much valuable information may be

derived from the scientific works of HUTTON, ATTWOOD, MOSELEY, GWILT, and others, on the subject." That the reference to some, if not all, of those writers was little more than complimentary, may be evidenced by the fact that amongst them GWILT, *Encyc.*, loc. cit., has adopted the doctrines of RONDELET "as much more satisfactory than any others with which he is acquainted." Now if the student be suspicious of the results of finding that RONDELET's experiments were made under the notoriously insufficient guidance of a small scale, he will be equally dissatisfied with having to take for granted the calculations founded upon the dictum repeated from RONDELET by GWILT, who, § 1371, after citing that author's experiments, says "from these considerations in applying the principles of mechanics to arches composed of freestone well wrought, a plane inclined at 30 degrees might be considered as one upon which the voussoirs would be sustained, or, in other words, equivalent to an horizontal plane." In order that no mistake may have been incurred, it seems desirable to cite RONDELET, *Art de Bâtir*, 4to., Paris, 1830, iii, 168, who says "from experiment it has been found that hard stones commence to slip at an angle of 30 degrees, and if laid in fresh mortar at angles of 34 to 36 degrees; but soft stones laid in fresh mortar at an angle of 45 degrees when the centre of gravity does not fall outside the base": and from 34 to 36 degrees is repeated by TREGOLD in Professor BARLOW's edition. This is noticed by HASKOLL, part ii, 95, who there gives as the result of Mr. GEORGE RENNIE's experiments at London bridge that the dressed voussoirs began sliding without mortar at $33\frac{1}{2}$ degrees, and with mortar fresh laid at $25\frac{1}{2}$ degrees; and moreover states, p. 163, that when a soft bed of mortar is interposed between two arch stones, the upper one will begin to slide if it have an inclination to the horizon which may be considered an angle of about 20 degrees—TREGOLD says 34 degrees. It must be confessed that there is a want of agreement, or rather of positive information, upon the very point upon which RONDELET's calculations seem to be based; and that this disagreement, so little creditable to the present state of science, involves nearly the whole practical question of the equilibrium of an arch, which should also include the effect of joggling the voussoirs to prevent sliding, and the use of cements.

To some extent, however, it is satisfactory to know that GWILT, who in the same place has given RONDELET's opinion of the views held upon this subject by DE LA HIRE, COUPLET, BERNOULLI, DANIST, FREZIER, COULOMB, and BOSSUT, says very justly of the classic builders, and might have included the mediæval masters, that "the investigation of the equilibrium of arches by the laws of statics does not appear to have at all entered into the thoughts of the ancient architects; experience, imitation, and a sort of mechanical intuition seem to have been their guides; they appear to have preferred positive solidity to nice balance, and the examples they have left are rather the result of art than of science"; a conclusion which, with respect of mediæval practice, is undoubtedly the same as that entertained by VIOLET LE DUC, *Dict.*, throughout the whole of the elaborate article "Construction".

PLAYFAIR; WHEWELL; ROBISON; IVON DE VILLARCEAUX; HANN and HOSKING, *Bridges*; WEISBACH, *Mechanics of Machinery and Engineering*; with other publications, mentioned s. v. ARCH and BRIDGE.

EQUISETUM HYEMALE, the winter horsetail, also called shave-grass. A cellular marsh plant found abundantly in the low boggy grounds of Holland and England. The stem, about a foot in height, is covered with a skin so full of silicate of potash, that the dried stem was used to polish woods and metals. The invention of sand-paper and of emery-cloth has superseded for that purpose this Dutch rush, which is however the best file that is known for alabaster, casts in plaster of Paris, marble, etc.

ERA. An astronomical or historical point, from which a series of civil years is counted. The best small work upon the

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different eras is that in the Cabinet Cyclopædia, by NICOLAS, *Chronology of History*, 12mo., London, 1838; which includes the mode of transferring into years from the Incarnation the era of Spain, commencing B.C. 38; and the era of the Hegira, commencing 16 July A.D. 622, which is useful for Spanish and Oriental buildings: but as that book does not enter upon Hindu chronology it may be useful to state that the chief historical eras of India (besides the Hegira) are the Samvat or Vicramaditya, beginning according to TOD, *Annals*, 4to., Lond., 1829, ii, 240, 599, sometimes at B.C. 66, but generally at B.C. 56; and the Saca or Salivahana, commencing, according to BUCHANAN, *Journey through Mysore*, 4to., London, 1807, i, 230, ii, 202, iii, 27, at A.D. 77 in the north, but at A.D. 78 in the south; and it may be further observed that the Kaliyuga differs also being seven years more in the south than in the north, where it is held to have commenced B.C. 3101. Besides the work first named, notice may be taken of the COMPANION TO THE ALMANAC, 12mo., London, 1830, pp. 1-32, which gives almost all the information generally necessary to the calculation of the date, in one era, that shall correspond to any given time in another, except with regard to ancient history, for which reference should be made to CLINTON, *Fasti Hellenici*, 4to., Oxford, 1851, who shows, iii, 284, the Roman consuls for the years B.C. 280 to A.D. 14, and *Fasti Romani*, 4to., Oxford, 1850, ii, 180, those for the years 14-579: the earlier consuls are best learnt from SIGONIUS, *Fasti*, fol., Venice, 1555. The Jewish era gives the year 5620 as commencing 17-18 September, A.D. 1859.

ERAI or ERAY. A tank or reservoir formed by throwing a mound or bank across a valley or hollow ground, so that the rain water collects in the upper part of the valley and is let out on the lower part by sluices for the purposes of cultivation; thus differing from the 'culam', which is the tank for domestic purposes formed by digging out earth, and is destined for supplying water. BUCHANAN, *Journey through Mysore*, 4to., London, 1807.

ERAMBOO. A tree of Travancore, East Indies. The wood is dark brown in colour, and is used for common houses. 71.

ERCOS, see HERKOS.

ERDE HOUSE. A name given in the north of Scotland to one form of the subterranean chambers found in that country, as described in the *Builder Journal*, 1853, xi, 568.

ERECHTHEION, or Temple to Erechtheus, see ATHENS, p. 117.

ERECTION. A vertical construction or piling up of materials one on the other.

EREING OF LAND. A quantity consisting of twelve acres, according to a customary of the priory of the Holy Trinity at Norwich, cir. 24 Edward I; BLOMEFIELD, *Hist. of Norfolk*, 8vo., London, 1810, p. 169.

EREMACAUSIS. The name given by LIEBIG to the process of slow combustion which takes place when moist vegetable substances are exposed to oxygen: one portion of the gas combines with the hydrogen in the wood to form water; while another liberates a volume, equal to itself, of carbonic acid. Decomposition takes place when one body comes in contact with another already undergoing the same change, in the same manner that yeast produces fermentation. Animal matter enters into combination with oxygen in precisely the same manner as vegetable matter; but as, in addition to carbon and hydrogen, it contains nitrogen, the products of the eremacausis are more numerous, such as carbonate and nitrate of ammonia, carburetted and sulphuretted hydrogen, and water; and these greatly favour the growth of fungi, which in timber are collectively called DRY ROT. These fungi derive their nourishment from the substances on which they grow, and contain a larger proportion of nitrogen than most other vegetable substances, and the substance called fungine has a near resemblance to animal matter. Their spores are extremely numerous and minute, and are diffused very

widely, developing themselves wherever they find organic matter in a fit state. The principal conditions required for their growth are, moisture, heat, and the presence of oxygen and electricity. No decomposition or development of fungi takes place in dry organic matter, nor does decay occur either in a temperature below the freezing point of water, or in situations where the oxygen of the atmosphere is excluded: the *CIVIL ENGINEER Journal*, 1850, xiii, 206; which also, 1843, vi, 386, notices the carbonaceous matter, resulting from the slow combustion of gluten and starch, by which the pipes conveying brewers' worts are often stopped.

ERFURT. A city, formerly the capital of Thuringia, but now of the government of its own name, in Prussian Saxony. It is defended externally by the citadel called Cyriaksburg, and within the walls (which have six gates) by the fort named Petersberg. The most remarkable edifice is the cathedral without transepts, situate on a height and having a long flight of steps on the outside of the choir, to the three-sided porch which opens into the eastern bay of the north aisle of the nave; this porch, which has its walls at an angle of 60° with the main structure, somewhat resembles that at Ratisbona, and, with its two doorways, belonging to the early part of the fourteenth century, is highly praised. The nave, dating 1472, is joined by a narrow arched opening to the choir by a wall which carries a central tower rising from between one on either side, an idea resembling that adopted in the cathedral at Constance, and repeated at Erfurt in the church of S. Severus. The fine choir has its eastern extremity advantageously supported by a terrace upon arches which conceal the natural rock and give an effect of extraordinary height to the choir, which itself is very tall, and dating 1353 is furnished with windows full of late but brilliant glass. This edifice has recently been repaired. The two stately towers are said to have been erected in the twelfth century: the cloister has a range of tracery belonging to the thirteenth and fourteenth centuries: the bell called the Grosse Susanna, and dated 1447, is reported to weigh 275 cwt. On the same plateau, and only about 35 ft. from the north side of the cathedral, is the church of S. Severus, very much of the same design, but its spires, although the mass of tower is smaller, seem to rise even higher than that church; it has little remarkable in the interior except a font with a cover 30 ft. in height, which is a curious example of interpenetrating stump tracery, dated 1467; the window tracery, as in the cathedral, would be called in England work of the Late Decorated period. The Barfüsser-kirche, with nave, aisles, and absidal choir, all groined to one height; the Prediger-kirche, dating 1228, 225 ft. long in fifteen bays, having a nave of moderate height with narrow aisles; another church with two western steeples, one of which has a spire rising from the gabled sides of the tower; another on a triangular site with the tower at the western angle; a rath-haus dating 1259; and a private house with a large bay window between two traceried windows, having another over it in the gable; are the chief objects mentioned in the *ECCESTOLOGIST Journal*, 1855, xvi, 75.

ERGASTULUM. A term which may be translated literally, a workhouse; but in fact the dwelling of the slaves who were confined in chains, 'vincti'. The word is frequently used by classic authors, but especially by *JUVENAL*, xiv, 24. Of their architectural features little is known except that *COLUMELLA*, i, 6, speaks of them as quite as much adjuncts to a farm as the barns, etc. He directs them to be made underground with narrow grated loopholes for windows, so high from the floor that they could not be reached, which he coolly calls 'quam saluberrimum'. So great were the cruelties exercised in these places that they were abolished by the emperor Hadrian. *ÆLIUS SPARTIANUS*, *Vit. Had.*, 18.

It is evident that this term is improperly applied to the set of two, three, or more dark rooms which occur in the houses at Pompeii, and have been supposed to have been the sleeping

places for the servants; these rooms, in fact, are almost always decorated in such an elegant way as to make it impossible to believe they ever were occupied by slaves. They probably were used as apartments for the siesta, or sleeping in the day time, and the ground of the walls being painted black, would make them comparatively dark and cool in the heat of the day.

A. A.

ERION, see **HEROUM**.

ERISMA or **ERISMATA** (Gr. *ἐρίσμα*). A prop or stay; "the sceptre the prop of his right hand", *EURIPIDES*, *Hercul. Fur.*, 251; props to keep a boat upright when on the beach, *THEOC.*, xxi, 12. *VITRUVIUS* (vi, 11, and compare x, 1) uses the word in the same sense as **ANTERIDES**.

A. A.

ERIVAN. The capital of the government of Armenia in Asiatic Russia. The houses are only one story in height, chiefly built of unburnt brick and mud, standing each in its own garden fenced with clay walls; the city is enclosed by a wall only 13 ft. in height. A handsome stone bridge of several arches; a large bazaar; two caravanserais; several baths; an old octagonal tower with a domed top, which has no known date or use; five Armenian churches and as many mosques, are to be seen. *DUBOIS DE MONTEREUX*, *Voyage*, fol., Paris, 1839-43, iii, 332-45, and pl. 23-7, has given coloured illustrations of the great triple-domed mosque; of a mosque (where a bomb has gone through the dome without doing any serious injury), this building has been made an arsenal by the Russians, and he admits that the minarets shewn by him do not exist: views of the inner court, 211 ft. long and 135 ft. wide, of the harem and of the salle des glaces, 44 ft. long and 23 ft. wide (the ceilings, columns, and walls 20 ft. high, all but the plinths are of glass) in the palace of the Sirdars (or viceroys after the Persian conquest in 1635), which stands, with the houses of the public functionaries, and two mosques, one being now the arsenal above named, and the other having been converted with the addition of four porticoes into a Russian church, within the almost oval fortification called a castle, surrounded by a triple wall and seated on the summit of the hill on which the town is built.

ERLACH (**FISCHER VON**), see **FISCHER**, baron von Erlach (**JOSEPH EMANUEL**).

ERLACHER (**MICHAEL**) restored 1744 the tower of the cathedral at Strasburg, that had been struck by lightning. 68.

ERLAU, in Hungarian **EGER**. A city, the capital of the county of Heves, in Hungary. The town, still enclosed by walls with six gates and commanded by an old castle, was the seat of an episcopal see until 1802, since which the see has become archiepiscopal. The cathedral, measuring 252 ft. by 120 ft., was designed by Hild under a commission from the late archbishop Pyrker, of the Esterhazy family, to show that a classic style of architecture with the retention of the mediæval form of the Latin cross is as well adapted as the Gothic for the service of the Roman Catholic Church. The cruciform plan is surmounted by a cupola, and has a portico of columns, 50 ft. high, of the Corinthian order and carrying a decorated pediment, at the end of the nave and of each transept. The same spiritual prince erected also, at his own expense, the university or lyceum, cost £200,000, in 1797, and the barracks for his contingent of 2,000 men. The episcopal palace, the hall for assembly of the states (comitatshaus) of the district, and the barracks, are the other chief objects of architectural importance. 23.

ERMENT and **ERMONTIIS**, see **HERMONTIS**.

ERNULPH or **EARNULPH**, see **ROCHESTER**.

ERRARD (**CHARLES**), born 1606 (*NAGLER* says 1601) at Nantes, became 1666 the first director of the French Academy at Rome, where he died 25 May 1689. During the tenure of this appointment he procured measured drawings of the principal modern edifices in that city, which appear to have fallen into the hands of Blondel. His architectural skill seems only to have been exhibited in the circular church of the

Filles de l'Assomption, near the porte S. Honoré at Paris, the first stone being laid in August 1670; it was completed 1676, but the only illustrations (those numbered 72 or 420 in the Grand Marot) which are given in BLONDEL, *Arch. Franç.*, fol., Paris, 1752, iii, 139, are allowed by him not to be very faithful as to detail. BLONDEL, *Cours*, 8vo., Paris, 1771, i, 206, 216; ii, 322; iii, 365-7. In the edition 1702 of the *Parallèle*, it is stated that the first edition, fol., Paris, 1650, was the joint production of Errard and R. Freart, Sieur de Chambray.

ERWIN VON STEINBACH, see STEINBACH.

ERYTHROXYLON AREOLATUM, of Jamaica, produces an iron-wood, also called red-wood and rose-wood.

ERZEROU, ARZEROU, or ERZ-RUM. A city, the capital of the pashalic of the same name, in Turkish Armenia. As it was well nigh destroyed in about fifteen seconds by an earthquake 2 June 1859, it is only necessary here to observe that a general description of the town as it was in 1842 is given in CURZON, *Armenia*, 12mo., London, 1854. TENIER, *Descr. de l'Arménie*, fol., Paris, 1842, has given, pl. 4-11, a general view of the town; plan, section, details, and view of the imaret belonging to the mosque called the 'oulou djami', with two minarets in front, whence its name of tchifte-minareh, used as a powder magazine, and which shows the double-headed eagle, a device of the sultan Ala Eddyn the Great, 1072-92; and a view and details of the Mourgo-serai (which exhibits the lion, probably as a rebus for the sultan Alp Arslan, 1063-72), which had been converted into a barrack. Amongst the writers who have described the town may be included SOUTHGATE, *Tour through Armenia*, 12mo., New York, 1840, i, 178; and HAMILTON, *Asia Minor*, 8vo., London, 1842, i, 179.

ESCALANTE (LUCAS DE) and Pedro de Tolosa were selected by J. B. de Toledo as the two resident architects, with the title of *aparejador*, at the commencement 1563 of the works at the Escorial: their services were so satisfactory that a royal order, dated 19 December 1566, prescribed that they should not be suspended or removed unless by the mutual agreement of the prior, treasurer, and architect. For some reason which has never transpired, unless it might be supposed to be Escalante's marriage to the sister of Tolosa, the post was given 19 April 1576 to Juan de Minjares alone; Tolosa being removed with a higher salary to Uclés; while Escalante, with no disadvantage to himself, took the place of Minjares at Aranjuez, where he died in October 1579. 66.

ESCAPE, see SCAPE.

ESCHEL. The blue sand, or fine grey substance resembling ashes, which is deposited by the third washing of the glass of cobalt: the name is also given to a shade of cobalt blue. ROYAL SOCIETY, *Philosophical Transactions*, No. 396.

ESCOINSON, see SCOINSON; SCONCE; and SQUINCH.

ESCOT (PIERRE L'), see LESCOT (PIERRE).

ESCUCHEON. A term imported into the nomenclature of architecture by WHEWELL, *Arch. Notes*, 8vo., Cambridge, 1842, p. 112, who says the wall at the ends of the (pointed) vaulting cells has the form of an inverted escutcheon, and is (here) designated by that word: and p. 171, he applies the term 'shield' to the wall in the same case with elliptic vaulting.

ESCUADERO FERNANDEZ (ANTONIO) was one of the twelve architects examined 1694 upon the stability of the collegiate church of S. Salvador at Seville, to which he was then acting as *aparejador*; in his evidence he is styled 'maestro arquitecto de cantería'. 66.

ESCLAPIUS (TEMPLES TO), see ÆSCULAPIUS.

ESCURIAL (Sp. *Escorial de Arriba*). A town in the province of Madrid, and situated about twenty-five miles to the north-west of that city, in Spain. The church, 150 ft. long and 52 ft. wide, was designed by Francisco de Mora; the theatre, by Jayme Marquet, a French architect, dates between 1758 and 1782; Juan de Villanueva built 1768 a house for the consul of France, another for the marques de Campovillar, and others for the princes of the royal family and for some of the

ministers. This town, however, is only mentioned here as having given its name to the monastery of S. Lorenzo, now called the Escorial. An injunction of Charles V, that a sepulchre for the royal family should be provided, and the gratitude of Philip II for the victory at S. Quintin gained upon the festival of S. Lorenzo (10 August) 1557, were the combined motives under which the monastery was built. The statements made by MILIZIA, *Vite*, s. nn. Alessi, Danti, Foix or Fox, and Barozzi da Vignola, with regard to the employment of any French or Italian artists on this edifice, are repudiated by LLAGUNO, *Noticias*, 4to., Madrid, 1829, who notices the public sale (probably about 1775) of original drawings that had fallen into private hands after a fire at the palace in Madrid. This author at least establishes the fact that on the first stone, laid 23 April 1563, was the name of Juan Bautista de Toledo, who for this work was summoned 15 July 1559 from Naples: in 1563 he had an allowance for at least two pupils, G. Gili and perhaps Juan de Herrera, to be educated on the works, and he appointed as *aparejadores*, or clerks of the works, Pedro de Tolosa and Lucas de Escalante, who fulfilled the duty until 19 April 1576. The design made by Juan Bautista, and carried on by him until his death 19 May 1567, embraced a residence for fifty Hieronymite monks, another for the sovereign, and a church between them. The plan has always been said to resemble a gridiron, the instrument of the martyrdom of S. Lorenzo, the handle being the projection in the east front; but the resemblance, if any were intended, is very slight. The original idea was an edifice, of the Doric order, 580 ft. long from east to west, and 744 ft. from north to south.

Juan Bautista was succeeded by Juan de Herrera who, to accommodate double the number of monks, raised the lower portions of the existing building. He also moved the site of the bell towers from the east front to the west end of the church, and had the credit of designing this important portion of the edifice. It should be observed that as the design left for it by Juan Bautista was considered to have in it little that was unusual, the king had obtained before 22 February 1573 designs from several architects; amongst which the project suggested by Pacciottio was preferred, although its merit was disputed as being little more than a variation of S. Peter's. Upon this groundwork, but with some alteration of his own, Herrera began 1574 the foundations, but he was soon checked by the opposition of the contractors to his specification that the stone should be partly worked in the quarry: he showed, however, that this practice was not a novelty, and having obtained 19 April 1576 Juan de Minjares as *aparejador*, the work was completed in six years; whereas it was calculated that under the system of working the stone on the ground, twenty years would have been consumed. The stone used throughout the edifice is a white granite with talc and grey spots, which had delicately worked joints and was carefully polished in place.

The central gate of the west front leads by a porch into the atrio or patio de los reyes, 230 ft. long by 136 ft. wide, which is surrounded by buildings of five stories in height; at the east end is the vestibule to the church, 138 ft. long and 20 ft. wide. Behind the vestibule rise the towers, each 180 ft. high to the topmost cornice, or 260 ft. high to the extremity of the spire. Between them is the church, of the Doric order externally and internally (with oblong metopes), and 364 ft. long, 230 ft. wide in the transepts, and 170 ft. high, the nave being 53 ft. and the aisles each 30 ft. wide. The capilla mayor or presbiterio is only 60 ft. long and 30 ft. wide. In consequence of a settlement in one of the piers intended to support the dome, Herrera in spite of his conviction that the pier had come to its bearing, was directed to omit 11 ft. in height of the wall under the upper external columns, and to lighten as much as possible the stone cupola 66 ft. in diameter, which stands upon a square drum and is finished with a cross, placed 23 June 1582, at 336 ft. above the pavement. Behind the church is the patio de los mascarones, surrounded on three sides by the royal apartments.

On the south of the church is the patio de los Evangelistas, 166 ft. square, surrounded by the principal cloister of two stories (Doric and Ionic orders) in height, 24 ft. wide, each having forty-four arcades. In the centre of the west side is the staircase designed (it is said) by Juan Bautista Crescenzo marques de la Torre, called il Bergamasco, which has always been considered in Spain a subject for especial study, and certainly its convenience does credit to its large size, 50 ft. long by 41 ft. wide, and 82 ft. high. The south side of this staircase forms the north wall of the "old church", which was the chapel, 105 ft. long and 34 ft. wide, used during the construction of the edifice, and is suitably attached to the monastery, which includes four small courts. The same arrangement of a cross inscribed within a square gives the necessary accommodation for the college and seminary, originally the offices for the royal residence and for the monastery, at the north-west angle of the edifice. The last stone of this vast structure was placed in September 1584 on the cornice of the atrio de los reyes: immediately afterwards the health of Herrera failed, and the completion of the finishings was entrusted under his direction (until 1594, and perhaps until his death 15 January 1597) to Francisco de Mora, who probably made the perspective view and prepared the geometric drawings that were engraved 1587 by Pedro Perret. Under Mora also were begun 1589 the buildings adjacent to the monastery, viz. casa de la Compañía, containing the offices and storerooms, the hospital, and many apartments, together with the gallery conducting to it; the magnificent basin in the gardens; and the two casas de oficios serving as quarters for the royal retinue. The mina or tunnel, 181 ft. long, 10 ft. high, and 7 ft. wide, to these last buildings was designed 1744-74 by Fray Antonio de S. Josef Pontones.

Amongst the lessons taught by this edifice may be counted the fact that as early as 1604, it was discovered that the rain water which was collected in the gutters formed in the cornices of the cloister de los Evangelistas, was penetrating the joints of the stone and damaging the arcades beneath: the cost of the necessary alteration to prevent further mischief was estimated by Mora at 30,000 ducats, about 5,000 guineas of that day.

Nearly under the high altar is the panteon or sepulchre, at first merely a vault constructed by Herrera; its decorations were designed 1618-9 by J. B. Crescenzo, under whom the chamber thus appropriated became 36 ft. in diameter, 38 ft. high, octagonal in plan, enriched with coupled Corinthian columns at the angles, and containing on each side four shelves for the sarcophagi, except where the door and altar occur. The contract for the marble lining above the cornice, to be done according to the drawings by Juan Gomez de Mora, is dated 18 April 1620, but before 1627 the works began to slacken, until the suggestions of Fray Nicolas de Madrid as to the means of getting air, light, convenient entrance from the north instead of the south side of the church, and drainage of a land spring that is still heard trickling behind the masonry, were carried out by Alonso Carbonel, including the staircase, doorway, pavement, and altar. These were executed by Bartolomé Sombigo or Zombigo, who completed the vault and its sarcophagi, which were first used 17 March 1654; and he later obtained considerable credit for the repairs, completed 1678, rendered necessary by a fire which, beginning 7 June 1671, lasted for a fortnight, and destroyed almost everything except the church and the royal apartments: in 1679 he also repaired the serious damage caused by lightning to the cupola. Considerable alterations to the entrance, vestibule, and staircase on the north side, seem to have been effected soon after 1768 by Juan de Villanueva; but although the damage done 1808-14 to the internal decorations was repaired, it does not appear that much has been done to preserve the edifice from the decay consequent upon its abandonment at the sequestration of the monastic establishments.

Considerable space has been devoted to this edifice, its history and description having rarely been justly given; and in

almost all accounts of it the dimensions have been stated as above without notice that they are in Castilian feet, bearing the proportion of 33·38 to 36 ins. English measure. The monastery has been described by SIGÜENZA, *Historia de la Orden de S. Geronimo*, part iii, fol., Madrid, 1605; and by XIMENES, *Descripcion*, fol., Madrid, 1764, which last work has some of the plates from, and is founded upon, DE LOS SANTOS, *Descripcion*, fol., Madrid, 1657, and several other editions, besides an English translation by THOMPSON, 4to., London, 1760. One perspective view is given in TAYLOR, *Voy. Pitt. en Espagne*, 4to., Paris, 1826-42, pl. vol. i; and one in the *MOYEN AGE MONUMENTALE*, pl. 381.

The tower and houses of the Campello, replacing a hamlet, to the north-east of the monastery, were begun 1621 from the designs of Juan Gomez de Mora.

ESELLER, ESSLER, or OESLER (NICOLAUS) of Alzei or Alzey, was probably the stone mason Nicolaus, mentioned under the date 1429, and afterwards in the accounts of a church at Noerdlingen; in 1442 the name appears with that of his son Nicolaus as the *werkmeister* to the church of S. George in that place, whose proceeding, which seems to date 1442 or 1454-59, was so unsatisfactory, with respect to the nave, that it was submitted to some kind of arbitration; they were afterwards engaged at Augsburg and Rothenburg. At Dinkelsbuehl, however, he and his son of the same name seem to have given great satisfaction from 1442 till 1450, as their portraits were or are still suspended in the highly praised church, 1444-99, of S. George in that place. 68. 92.

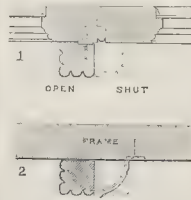
ESMOONAYN. The modern name of HERMOPOLIS MAGNA in Egypt.

ESNEH or ASNAH. The modern name of LATOPOLIS in Egypt.

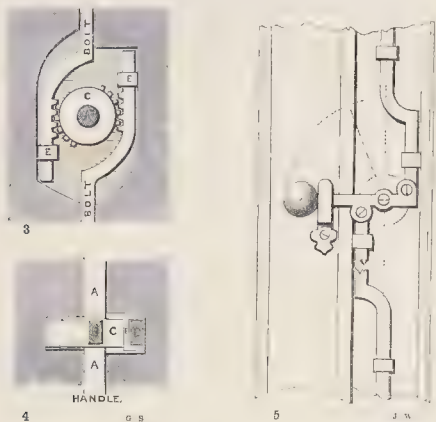
ESONARTHEX (Gr. ἔσω, within). The inner or narthex proper of the early Christian Church. EXONARTHEX; NARTHEX; BASILICA. A. A.

ESPAÑOLETTE BOLT. A fastening used for casements, consisting of a bolt, slightly longer than the casements, confined by rings and furnished at each end with a hook, and at the proper height from the ground with a handle hinged in two places. A hook or knuckle is fixed to the adjoining casement, and metal plates hollowed out are let in flush into the sill and head of the window frame or into the sill and transom, if there be one, to receive the hooks at each end of the bolt. The casements being pressed together, the bolt (which occupies the place of the bead at the meeting stiles) is, together with its hooks, turned by the handle, and the hooks entering the plates hollowed out to receive them, force the flaps of the casement closely and firmly together. The handle is then turned down behind the hook or knuckle, which should be placed so as to cause the handle to fit tightly into it, and the casement is by these means fastened in three places. Espagnolette bolts are made both of iron and of brass, and being expensive, and requiring to be made expressly according to the height of the casements and positions of the plates in the head and sill, their dimensions should be given to the maker by some one understanding their use both as regards their length and diameter. A. H. M.

The accompanying cuts show a cheap and efficient mode of closing windows adopted at Pisa, as given in the *Papers of the Royal Engineers*, 4to., Lond., 1849, x, 187. The upright square bar in fig. 1 is moved to or from the sash, as the window is required to be opened or shut; the bottom and top of the bar being cut into a rounded form, as shewn in fig. 2, so as to fold into the two segmental plates secured to the sill and lintel; (the drawing has been unintentionally made 'left handed').



Another mode of fastening casements consists in a pair of bolts in one vertical line and made to shoot in opposite directions. Fig. 3 shows the mechanism of the 'bascule', 'swipe', or 'seesaw', much used in Germany and France instead of the espagnolette; the details for which have been furnished by Mr. Strong of Hamburg. Fig. 4 is the plan belonging to it. This



fastening is sunk in the stile. The action of another variety of this bolt, fixed on the stile, will be readily comprehended from fig. 5; when the lever is horizontal, the casements or doors are fast, and they are released by raising the knob so as to turn it to some extent around the axis. Smith's patent Fastening, given in the *BUILDER Journal*, ii, 208, is a bolt with threefold motion working in a case let into grooves ploughed out of the rebates.

Details, at full size, of an espagnolette showing the way of making the bolt fasten the inside shutters as well as the sashes, are given in MANDAR, *Études*, fol., Paris, 1826, pl. 106. In the *BUILDER Journal*, 1849, vii, 543, details to scale, furnished by a French architect, are given, describing the espagnolette as made in France. In the Exposition at Paris in 1855, espagnolettes were exhibited under the name of *crémones*; some being sunk in the stile, others not.

Espagnolette handles are often used without bolts to small casements.

ESPÉE, see DELESPÉE.

ESPINE (. . . L), see LESPINE.

ESQUERRA, see EZQUERRA.

ESSABOUBA in Nubia, see SABOUBA.

ESSEX (JAMES), F.S.A., born 1723, was the son of a carpenter and builder at Cambridge. He received his education in the grammar school attached to King's College, learnt architecture (classical) under Sir James Burrough, and was the first professional man in the last century who made Gothic architecture his study and practice; to this he was probably led by his engagement 1757 to make drawings for the work on Ely cathedral by BENTHAM. At Cambridge, he erected the pulpit and desk in the church of S. Mary the Great, 1739; the reredos in King's College chapel; the chapel (Italian Corinthian), 1763-9, from the designs of Sir J. Burrough, at Clare College; with the cycloidal bridge, the combination room, and alterations to Neville's court, at Trinity College. He published designs for the new buildings of Benet's (now Corpus Christi), King's, and Emmanuel Colleges; Trinity hall; and the public library; which were engraved in 1739, 1741, 1743, 1748, and 1752: his design for the first having been disputed by the historian of that college, Essex published *A Letter to his Subscribers to the Plan and Elevation of an intended Addition to Corpus Christi College in Cambridge*, 8vo., Camb., 1749, which effectually closed the dispute. He designed the shire hall, 1747, and the guildhall, 1782, both Italian; and in 1779 propounded a scheme for improving the navigation be-

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tween Clayhithe and Littleport. At Ely cathedral, about 1760, he restored the east front to the perpendicular; new roofed the whole of the choir; altered the choir, with a new west screen and organ loft, now pulled down; altered, repaired, and strengthened the lantern, 1757-62; and advised the pulling down of the Galilee and south-west transept, as being 'neither useful nor ornamental', and 'not worth preserving'. At Lincoln cathedral he designed the reredos; and the open parapet of the central tower. He repaired the tower of Winchester College chapel; made a survey of Canterbury cathedral; and repaired and improved Madingley in Cambridgeshire, for Sir John Hinde Cotton, bart.: the improvements at Merton and Balliol Colleges, Oxford, were adopted from his plans; those for Magdalen College were exhibited in 1797.

Besides the publications above mentioned, he wrote *Remarks on the Antiquity of different Modes of Brick and Stone Buildings in England*, in the *ARCHÆOLOGIA*, 1777, iv, 73; *Observations on Lincoln Cathedral*, iv, 149; *Origin and Antiquity of Round Churches, and of the Round Church at Cambridge in particular*, 1782, vi, 163; *On Croyland Abbey and Bridge*, in *BIB. TOP. BRIT.*, No. xxii, App., p. 177, 4to., 1790; and in 1756 printed a *Proposal for publishing Plans, Elevations, and Sections of King's College Chapel, in Fifteen Plates, with Observations on the Original Contracts*, which, however, was not carried out. His MSS. and drawings are in the British Museum. He died at Cambridge 14 September 1784, aged 61, and was buried there in S. Botolph's churchyard. BOWTELL MS., v, 1013, in Downing College library; NICHOLS, *Lit. Anec.*, 4to., 1812-15, vi, 624; *Illustrations of the Literature of the Eighteenth Century*, 4to., London, 1817-58, vi, 284-310; COOPER, *Annals*, 8vo., Cambridge, 1842-3, iv, 412; WILLSON, in preface to PUGIN, *Specimens*, 4to., London, 1821, p. 16.

ESSOUAN in Egypt, see SYENE.

ESTEBAN (FRANCISCO), to whom the church of the Santa Cruz at Madrid (about 1765) is attributed, is supposed to have been a son of FRANCISCO, arquitecto y Alarife, of Madrid, who was employed as aparejador interino on the old palace at Val-sain 1717; on the villa of la Granja 1721; and afterwards on that of Buen Retiro, where he also worked some portion of the church of S. Bruno until at least 1727.

ESTEREL GRANITE. The granite obtained from the Esterel chain of mountains in the department of the Var, which constitutes a prolongation of the chain known by the name 'les Maures', is occasionally used in the south of France. The granite usually occurs in veins in gneiss; it is generally speaking of a rosy colour, with plates of white mica; the crystals are large, and sometimes the type of the mass becomes decidedly porphyritic. In some varieties tourmaline replaces the mica; and in others the granite passes into a pegmatite, or into a kaolin. The direction of the Esterel chain is east-north-east; and it forms the last line of upheaval on the main land of France, or the last lateral spur of the Alps. COQUAND, *Notice Minéralogique de l'Esterel*, in the *Bulletin de la Société Géologique de France*, 8vo., Paris, 1836, p. 107; MILLIN, *Voyage dans les Départements du Midi*, 8vo., Paris, 1807-11, ii, 499.

An obelisk of grey granite, formerly called Egyptian granite, but lately said to have come from the quarries of Estrelle or Esterel near Fréjus, was erected 1675-6 at ARLES.

ESTIDNUS. A name, found on coins, for the town generally called ASPENDUS.

ESTIMATE (Fr. *estimation*). This term has two significations; 1. The sum reported by an architect to his client as the probable amount for which a design may be executed; 2. The sum required by the builder or builders for carrying out a work according to the plans and specifications, after having carefully gone through the various items in detail; the statement of this sum is often called a proposal or TENDER. It is frequently found that a number of respectable builders, each tendering on the same plans and quantities, and each anxious to get

the work to be executed, will differ as much as 30 per cent. in their respective amounts: some probably having greater command of capital, and some having perhaps made fortunate purchases of the various sorts of material. It is not therefore surprising that the architect's estimate, which is usually only an approximation, should vary from the tenders. But it should do so within reasonable limits, otherwise it argues a want of skill in the practical part of his profession. The bad faith which has been exhibited in competitions, where an estimate has been put forward which the competing architect must have known was too low to ensure the proper execution of the necessary work, is not only a deception on the employer, but a fraud on his fellow-competitors. COMPETITION; MEASURING; QUANTITIES. A.A.

This calculation of the probable cost of a building, made before its execution, may be either approximate, or may form one of the elements of a definite contract.

At the present day, the usual practice with English architects and engineers is to present, with the designs submitted to their employers, approximate estimates of the probable cost of the works about to be undertaken; but as these estimates ought to include even the works which it is not customary or advisable to include in the builders' contracts, they should always be taken—to use a technical phrase—with a wide margin. It should in fact be the aim of the architect or engineer to state at once the maximum outlay the employer may be required to make, before he enters upon the work. When estimates for contract are, however, to be made, it is necessary to descend to closer details than it would be in the case of the approximate estimate; and therefore one custom (originating perhaps about 1825) has been for the parties about to tender for the works to name one or more surveyors, whose business it is to calculate the quantities of the various descriptions of works, in conjunction with the architect, and under his direct superintendence, unless he should appoint a surveyor to assist, in his name, in taking out the quantities. It is essential under such circumstances that the working drawings, specifications, and details, should be prepared with great care, so as to indicate, in fact, everything which may be required in the course of execution; for as the estimate can only be based on the indications so given, everything omitted in them will give rise to a claim for an extra—or, in other words, to an addition to the estimate. And architects as well as engineers have found that even when the quantities are taken out, it is well to require the priced bill of quantities from the successful competitor, as a basis for the valuation of additions, alterations, etc. The quantities upon which estimates are formed should be calculated as nearly as possible in accordance with the strict rules of mensuration; but occasionally customs of trade may render the application of this law very difficult.

By another custom of older date, contractors take out their own quantities, entirely at their own risk, the architect or engineer having previously made his own estimate of the value of the work. This course may save some trouble to professional men, but at any rate, it exposes the contractor to great risks, it tends to exclude a very numerous and respectable class of tradesmen, who are not disposed to assume the responsibility of calculating all the quantities required to enable them to estimate for a complicated piece of work. By another custom, which is of at least equal date with that first named, but which seems to be falling into desuetude, a schedule of prices was submitted by each competing builder, and the architect reported in favour of that which appeared to offer the most economical result. On the continent the custom is for the architect or engineer to form a detailed estimate of the quantities of the proposed work, and the competition then takes place by the parties tendering at so much per cent. above or below the schedule of prices officially appended to the estimate. The jobbing works and repairs in connection with the public buildings under the charge of the Commissioners of Her Majesty's Works, etc., are executed upon the basis of tenders at so

much per cent. above or below the official schedule of prices. In each of the last modes, at the conclusion of the job, the works are measured and paid for according to the schedule and tender. The continental system ought to render the architect or engineer very careful in the preparation both of his working drawings and of his estimates; and wherever it is strictly applied, and the original designs are not subsequently interfered with, the estimates so prepared need rarely be exceeded. No precautions in the preparation of an estimate can, however, guarantee its validity if (as is too often the case) the employer should alter his mind during the execution of the work. G. R. B.

The common modes of roughly estimating the probable cost of a building are, 1, by calculating it at so much per square of the area it is to cover; and 2, by calculating it at so much per cubic foot. Both these methods, however, must depend upon the results of the architect's own calculations, as many circumstances which may modify or extend the amount can only be known to the estimator himself, and thus any conventional price per square or per foot cube, may give a result at least as uncertain as any other crudely ascertained amount. Some remarks on these systems will be found in NOBLE, *Professional Practice*, 8vo., 1836; and in DONALDSON, *Specifications*, etc., 8vo., 1860. Among other works may be named REID, *Young Surveyor's Preceptor*, etc., 4to., 1848; DOBSON, *Student's Guide to Measuring*, etc., 8vo., 1843, enlarged by GARBETT, 8vo., 1853; GWILT, *Encyc.*, etc.

ESTLER. A former mode of writing ASHLAR.

ESTRADE. This French term, derived, according to BLONDEL, *Cours*, 8vo., Paris, 1771, iv, 282, from the Latin *stratus*, has been adopted in England for a raised portion of the floor of a state apartment serving to receive the throne or the bed. This portion of the floor was originally raised by several steps above the general level. Four inches, however, are named by VIRLOYS, *Dict.*, s. v., as the amount of difference required between the two levels in his time by this 'plancher de menuiserie'. BLONDEL states that subsequently, the platform or marche-pied being omitted because apartments were parquetted, the encinte of the estrade was marked by carpets, 'tapis de pied', and that therefore such stepped estrades were no longer seen except in chambers of dais, throne rooms, etc. The same author (adding the curious note that the estrades of divans and halls of audience among the nations of the Levant are called 'sophas') shows that he considered the term estrade to include the area reserved, as well as its floor; for he says that the estrade differs from the alcove, inasmuch as the latter is only supported by jambs, while the opening of the former has 'pour point d'appui', columns having at their base a balustrade; this balustrade stood upon the platform, where there was one.

It is remarkable that STUART, *Dict.*, translates this word by the terms 'an even or level space, a public road'.

ESTREGE, AUSTRIGE, ESTREG, ESTRICH, and ESTRYCH, BOARD. The only way to obtain a satisfactory notion of the material that was thus denominated, would seem to be the juxtaposition in chronological order of the notices that have occurred to the writer of this article. TURNER, *Some Account*, 8vo., Oxford, 1851, p. 241, mentions two hundred Norway boards of fir to wainscot therewith the chamber of our beloved son Edward in our castle of Winchester, 1253; and pp. 85 and 245, he notices that one thousand Norway boards were purchased to wainscot certain rooms in Windsor Castle, 1255. It does not appear clearly that the words 'of fir' are not an explanatory interpolation by this writer.

The SOCIETY OF ANTIQUARIES, *Wardrobe Account of 28 Edward I*, 1300, 4to., London, 1787, p. 119, mentions Estland boards, and these are described in the index as 'boards or deals from the East Country'; and 'Estrege boards' are therein described as wainscots: the editor may, like other authors, have used the word deal for oak plank, or he may have supposed that wainscot must invariably have meant deal; but

perhaps he intended to make a difference between EASTLAND boards and Estrege boards.

THE SURTEES SOCIETY, *Finchale Priory*, 8vo., London, 1838, has p. ii, 'Item plancha de quercu et de fraxino. Item centum de bordis de Estland emptis apud Novum Castrum'; 1306.

The *Addit. MSS.* 17361, in the British Museum, p. 8, has ccc bordis estreis, as purchased 1312-6, for Westminster, etc.

BRAYLEY and BRITTON, *Westminster Palace*, 8vo., London, 1836, notice p. 199, thirty Estrich boards bought for making an enclosure and two windows, 1329; p. 163, a hundred Estrich boards, 1347; and p. 190, six hundred boards called waynscot, 1365-6.

KENNETT, *Parochial Antiquities*, 4to., Oxford, 1695, p. 575, has copied from the accounts of the priory at Burcester, 'vi Estregbords, viz. waynscots empt. apud Steresbrugge iis. iiii.', 1424-6; which in his *Glossary* he defines to be eastern boards or deal boards brought from the eastern parts for wainscot and other uses.

BLOMEFIELD, *History of Norfolk*, 8vo., London, 1805, vi, 218 and 223, states that John Bery or Bury, 1434, desires "the chancel to be selyd with estrych bord." PECK, *Antiq. Annals of Stanford*, fol., London, 1727, xiv, 26, notes that William Bruges, 1449-50, desires "that the ii chapelles of our Lady and Saint George . . . be closid wyth ostrich boarde . . . as the clousure of pleyn borde there now."

THE ROXBURGH CLUB, *Household Book of Howard Duke of Norfolk*, 4to., London, 1844, has preserved, p. 23, the term Austrige boorde, 1481.

The *Journal of the ARCHAEOLOGICAL INSTITUTE*, ii, 181, has 'wainscots, Estrich borde, as deals of oak imported from the Baltic are termed in other documents.'

NICHOLS, *Illustrations, etc., of England*, 4to., London, 1797, p. 118, has 'in the cheffe chambre a standyng bed made with estrychborde having the hed on the same wise'; (and in another chamber within the chamber over the parlour) 'a standyng bed convey with estrich borde of beyond-see making'; and p. 122, a sprewse (cypress or spruce fir) chest and two old skaver (square) chests, value 2s. 8d.; an olde presse of wanskote 8s. 0d.; an other skaver cover of wainscott 4s. 0d.

It has been suggested that the term is a corruption of 'Oestreich', i. e. East Kingdom, and therefore perhaps Austria.

ETCHMIADZEN, see VAGARCHABAD.

ETERIO or ETERIUS, see ETHERIUS.

ETHELSTAN, see HEREFORD (ATHELSTAN OR).

ETHELWOLD (SAINT), see WINCHESTER (E. OF).

ETHIOPIAN, see NUBIAN ARCHITECTURE.

ETIENNE (. . .) designed and commenced the erection at Bordeaux of the old archiepiscopal palace, afterwards the hôtel du département (1790), de la préfecture (1799), the palais impérial (1801), the château royal (1814), and since 1836, the mairie and hôtel de ville: on his death, 1774, the work was given to Lacotte: BERNADAU, *Biographie*, 8vo., Bordeaux, 1844, p. 131.

ETLINGEN (JACOB VON) conducted the works of the tower to the *dom* at Frankfurt 1503-12 according to OTTE, but 1503-9 according to NÄGLER, following PASSAVANT, *Kunstreise*, 8vo., Frankfurt, 1833, p. 447, who quotes a paper drawn up by Etlingen as *werkmeister* 1505; gives his seal and mason's mark; and ascribes to him a design (preserved amongst the archives of the town) for the tower, which does not seem to have superseded the original scheme left by Hans von Ingelheim.

ETRUSCAN ARCHITECTURE. The origin and development of architecture in Italy is involved in all the obscurity consequent upon great antiquity and uncertain tradition. Its introduction is, however, due to the Etruscans, a nation apparently of mixed origin, whose rule in Central Italy dates from probably the twelfth century before Christ. Few subjects have been more fully discussed and disputed than the tradition of the Lydian migration and settlement in Umbria; it is sufficient

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here to record that, from the evidence of Etruscan art itself, it is reasonable to infer the fusion of three distinct races, the influence of each being clearly apparent. The presence of a Pelasgic, and therefore Asiatic, influence is sufficiently to be traced in the affinities, not only of the language, but also of the architecture and plastic arts of Etruria with those of early Greece; both betray the same Asiatic origin, and a comparison of the Pelasgic remains in Central Italy with those in Greece and Asia shows that they are all the production of cognate races, spreading westward at a very early period, and in prehistoric times. In like manner, the Etruscan bronzes and paintings of early date are characterized by the same stiff archaic style as the Æginetan marbles; but there is this marked difference in the succeeding stages of art in the two countries, that whereas in Greece both architecture and sculpture were rapidly developed and attained the highest pitch of excellence, in Etruria the influence of a third intruding race (the Rasena, an Indo-Germanic tribe, spreading southward from the Rætian mountains) appears to have checked and retarded all improvement; for art remained unprogressive and to a great extent unchanged, nor did closer contact, at a later epoch, with Hellenic art effect any striking improvement.

There is no historic evidence of the state or character of Etruscan architecture, and but little positive information has hitherto been gathered thereon; the tombs and a few remains of city walls being the only works which can with certainty be ascribed to this powerful and wealthy nation, who were masters of Central Italy for many centuries. That ruins of temples or of civic buildings are not to be found ceases, however, to be surprising when it is known that the tradition that timber was chiefly employed in their constructions, is amply corroborated by the interiors of the tombs, the ceilings of several hypogean sepulchres at Corneto, Vulci, and Cervetri, being formed in imitation of wooden beams cut in the tufo. There were doubtless temples raised with a more enduring material than wood. A nation—so remarkable for its religious observances and devotion, displaying so much taste and magnificence in everything relating to its private life, and evidencing skill and solid construction in the massive fragments of the city walls and strongholds—would hardly, as some writers have imagined, have rested content with wooden structures, excepting in the earlier stages of their existence as a nation: it can therefore only be presumed that the entire absence of such remains is due rather to the ruin with which Rome so mercilessly overwhelmed Etruria—a devastation that may have swept away intentionally every trace of the more important buildings. VITRUVIUS, iii, 2, upon this head gives but little information, and that little can hardly be considered of much value, as in his time, cc. B.C. 50, Etruria as a nation had all but perished—the whole country being, in fact, one vast Roman colony—her literature and records destroyed, her traditions even rooted out, and the very vases which now crowd museums sought after as objects of curiosity and wonder. He, however, iv, 7, describes two forms of temples as in use amongst the Etruscans; the first circular, and sacred to one deity only; the second rectangular, with a hexastyle prostyle portico, and having three cellæ side by side, dedicated to three deities, the centre larger than the other two for the principal divinity. The entablatures and cornices probably resembled in style the cornices to the tomb façades hereafter described, and the pediments were adorned with figures in bronze or terra cotta, in both of which art manufactures the Etruscans excelled.

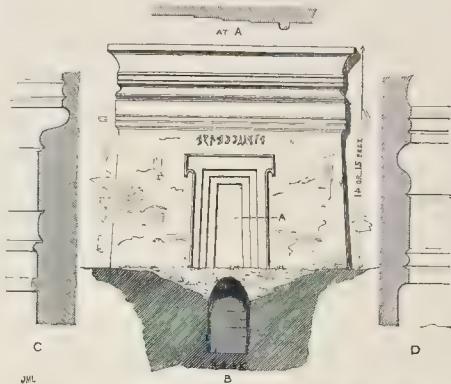
PLUTARCH, *Life of Publicola*, narrates that Tarquinius Superbus caused to be made by Etruscan artists at Veii, a chariot in terra cotta, which was destined by the king to crown the summit of the temple to Jupiter Capitolinus; the temple itself being also evidently a purely Etruscan building, having the triple arrangement before described. It is evident from this that the earliest Roman temples were modelled on the Etruscan plan; and indeed in religion, as in art and in law, Rome de-

rived much of her polity from this refined and cultivated people. The Roman house, with the special feature of the atrium; the wise and grand scheme of drainage by means of subterranean sewers of massive construction; the amphitheatre itself, so peculiarly a Roman institution; are all confessedly of Etruscan origin: but it is necessary to add that the remains of the amphitheatre at Sutri, though classed by NIEBUHR and others as a pure Etruscan work, is evidently of later and Roman times.

As practical architects and engineers their skill was remarkable: the cloaca maxima at Rome (another cloaca has been found near Tarquinii), the various emissaries tunnelled and vaulted by their artisans, prove their acquaintance with the art of construction at a very early period; whilst certain of their sepulchral chambers are vaulted in a similar manner to the remains at Mycenæ and Orchomenus, though inferior to these last both in size and excellence of workmanship. Of existing works—the city walls and tombs—the remains are of considerable extent and importance: the masonry of the former is of a very massive character, composed of large irregular blocks, often polygonal, generally rudely squared and arranged without cement in horizontal courses, but occasionally showing a perfection of workmanship unsurpassed elsewhere. DENNIS, *Cities and Cemeteries of Etruria*, 8vo., London, 1849, states that the style of the masonry differs in the northern and southern parts of Etruria. "In the northern districts, where the rock is difficult to be hewn, being either limestone, hard sandstone, or travertine, the walls are composed of huge blocks, generally rectangular in form, but of various sizes and irregular arrangement; whilst in the southern districts the masonry is less massive and very regular, being composed of tufo and other volcanic rock, which admit of being easily worked." The construction of the walls at Rusellæ corresponds very closely with the account given by PAUSANIAS of the walls of Tiryns in Argolis; small stones being intermixed with the larger blocks, some of which are of immense size, averaging from 6 ft. to 10 ft. in length, and from 4 ft. to 8 ft. in height; one stone measured 12 ft. 8 ins. by 2 ft. 10 ins.: the walls here in one place rise to a height of 20 ft., and are an example of the rudest and most ancient Cyclopean masonry in Italy. Similar to these are the remains at Arpino and Aufidena; in all these the stones are dressed to an even surface on the outer face, whilst those of the same early date at Olevano and Civitella are unhewn. It is evident that the faces have been dressed after the blocks were raised to their places, as the inner faces are left rough. In some, as at Praeneste, the joints are so closely fitted that a pen-knife cannot be inserted. Other important remains exist at Alatri, Cosa, Cortona, Civita Castellana, Fiesole, Ferentino, Norba, Populonia, and Volterra, which will be found fully described in the Dictionary under their respective names. The walls at Faleri, which have been considered by GELL and others as Etruscan, are undoubtedly a work of the Roman period. In the earliest of these works the gates are square headed, with huge stone lintels, as at Alatri; in later works the openings are formed into a pointed arch with approaching stones (similar to those in Greece), as at Arpino: one at Segni has a peculiar arched opening with a square head, similar in outline to a truncated pyramid; whilst at Volterra the circular arched head appears with the archivolt carved on the vousoirs. At Perugia the arch of Augustus is supported by late Etruscan piers considerably battered on the three faces, but the batter is produced by each course being set about an inch and a half within the course below it.

The tombs are of various kinds, but they may be classed under two general heads, those excavated in the rock or tufo, and those consisting of chambers in raised tumuli. Of the excavated tombs, some have façades cut on the face of the scarped rocks, which sometimes rise to a perpendicular height of 20 ft. on either side of ravines, as at Castel d'Asso, Norchia, and Bieda. The faces of these slope slightly backwards, and have false

doors diminishing towards the top with sloping architraves, the summits being crowned with cornices of a very peculiar character, generally receding from the face of the rock beneath, but in some instances, as at Sovana and the one at Castel d'Asso published below, projecting forward with a bold hollow and fillet of a very Egyptian character. The real entrances to these tombs are contracted openings below ground; over the lintels of the false doors are frequently inscriptions, recording probably the name of the owner. The accompanying illustration gives a good idea of the general character of these tombs.



A, N. cloaca of Arpino, Italy, to Faleri. B, T. S. cloaca of Arpino, Italy, to Faleri. C, D, T. S. cloaca of Arpino, Italy, to Faleri.

The architectural treatment in all is of so uniform and slight a description, that evidently the art had not then reached a high degree of cultivation. They are doubtless of a remote date, the interiors being of the simplest description, very different to the richly decorated tombs at Corneto and Chiusi; but at Norchia and Sovana are rock-cut tombs with façades of a richer character, having friezes and pediments ornamented with figure subjects in relief, and probably not earlier than the middle of the fourth century B.C.

Common as this form of sepulchre is in the above named localities, by far the most usual description of tomb is the raised tumulus, which is found in other districts in immense numbers; in the neighbourhood of Corneto alone upwards of six hundred have been counted; they are, however, never found in juxtaposition with the former. Here and at Vulci the tombs are dug out in the soil, they have one or more chambers approached by descending steps, and were surmounted by the tumulus, built with a basement of dressed stone with doors to give access to the chambers within; upon this basement, which is sometimes molded at top and bottom, was raised a pyramidal cone of earth. At Corneto and Cervetri the tombs have ceilings divided into square coffers sunk in the rock, the superincumbent earth being supported on massive square piers. It would be an endless task to describe the numerous varieties of these remains. At Chiusi and Corneto are the best examples of Etruscan polychromatic decoration. The subjects are chiefly funeral rites, games, banquets, and other ceremonials, which throw considerable light on the customs and religion of the people. The early paintings are rude and severe in outline, exaggerated in drawing, and crude in colour, strongly resembling the Egyptian paintings in general effect. This character is very marked in the treatment of the head, the eye being always represented full, even though the face is in profile. Later examples, however, such as the paintings in the grotta del Triclinio and the grotta Querciola at Corneto, are often full of dignity and grace, the compositions are masterly, the groupings and foreshortening of the figures admirable. The subjects are generally arranged in long friezes or processions, occasionally two deep; there is but little ornament, such detail being usually limited to bands or stripes of

red, blue, and yellow, to a wavy ornament, and here and there to a series of circles; the coffers in the ceilings are found contrasted with the beams in red and blue, and the angles of the pediments are usually filled with panthers and other animals.

This subject would not be complete without some allusion to the celebrated tomb of Porsenna, the only one, in fact, of which any description has reached us in the writings of antiquity. PLINY, *H. N.*, xxxvi, 19, 4, quotes the following account from VARRO: "He (Porsenna) was buried under the city of Clusium, in a spot where he has left a monument in rectangular masonry, each side whereof is 300 ft. wide and 50 ft. high, and within the square of the basement is an inextricable labyrinth, out of which no one who ventures in without a clue of thread can ever find an exit. On that square basement stand five pyramids, four at the angles and one in the centre, each being 75 ft. wide at the base, and 150 ft. high, and all so terminating above as to support a brazen circle and a petasus, from which are hung by chains certain bells, which, when stirred by the wind, resound afar off, as was formerly the case at Dodona. Upon this circle four other pyramids are based, each rising to the height of 100 ft.; and above these from one floor, five more pyramids, the height whereof VARRO was ashamed to mention; the Etruscan fables record that it was equal to that of the rest of the structure." Extravagant and puzzling as this description is, and exaggerated beyond the bounds of the credibility of even a PLINY, it is doubtless founded upon fact, and is by no means to be so summarily rejected as a fable as NIEBUHR has hastily and rashly concluded. Some light is thrown upon the subject by the monument near Albano, commonly known as the tomb of ARUNS. This monument is doubtless Roman, and of later date and considerably smaller than that of Porsenna, but its arrangement and plan well illustrate that of the Etruscan Lucumo. Here a subbase of 45 ft. square is surmounted with five conical pyramids, four at the angles 10 ft. in diameter, the centre one being larger and loftier. The upper portions of these are so broken away that it is impossible to tell how they were finished, but so far the monument corroborates the description given of that raised in memory of the great and powerful monarch. That such tombs were not unusual is evident from an analogous representation on an Etruscan stele published by RAOUL ROCLETTE, *Mon. Ined.*, fol., Paris, 1827-33, and from the cippi so frequently found in the tombs.

NIEBUHR has remarked that Etruria has received from the moderns more than her due share of attention and praise. However this may be, and although it may be admitted she can boast of no special feature in her architecture sufficiently marked to characterize a distinctive style, and although her people were not essentially a building race to the extent or with the innate feeling for beauty and proportion possessed by the Greeks, and were equally deficient in the sense of majesty and grandeur which renders the works of the Egyptians so expressive, nevertheless it is believed that enough has been advanced to prove that the Etruscans were one of the most remarkable races of antiquity, and that Etruria's influence upon Roman art renders the study of her remains a necessity to those who would rightly read and understand the latter.

DEMPSTER, *Etruria Regalis*, fol., Florence, 1723-4; GORI, *Museum Etruscum*, fol., Florence, 1757; MICALI, *Monumenti Inediti*, fol., Florence, 1841-3; ORIOLI, *Scoperte Edifici dell'Etruria Media*, 4to., Fiesole, 1826; RAOUL ROCLETTE, *Mémoires sur les Tombeaux de Tarquinies*, in *Journal des Savans*, 1828-43; INGHIRAMI, *Monumenti Etruschi*, 4to., Fiesole, 1821-6; DODWELL, *Views, &c., of Cyclopean Remains*, fol., London, 1833; TAYLOR, *The Stones of Etruria*, etc., 4to., London, 1859; ABEKEN, *Mittelitalien vor den Zeiten römischer Herrschaft*, 8vo., Stuttgart, 1843; CANINA, *L'Antica Etruria Marittima*, fol., Rome, 1846; GELT, *Topography of Rome*, 8vo., London, 1834; GRAY, *Tour to the Sepulchres of Etruria*, 12mo., London, 1841, and *History of Etruria*, 12mo., London, 1843. J. M. L.

ARCH. PUB. SOC.

EUCALYPTUS or Gum tree. A very plentiful, strong, and durable wood of Van Diemen's Land, used in ship building and for building purposes generally.

E. piperita, Blue Gum tree of Port Jackson, often rises to a height of 200 ft. without a branch in the first 100 or 150 ft. A single plank imported 1851 into Liverpool, which measured 100 ft. in length, 30 ins. in width, and 3 ins. in thickness, sold for more than £100. The wood is hard, and difficult to work: ARCHER, *Pop. Econ. Botany*, 8vo., London, 1853, p. 340. The colour is similar to that of dark Spanish mahogany, with a blue, sometimes a purple-grey cast.

E. globulus, Blue Gum tree of Van Diemen's Land, is said to be equal to oak for ship building, and may be obtained in beams of any dimensions up to 200 ft. in length. A tree near Tobosa on the northern aspect of Mount Wellington range measured upwards of 30 ft. in diameter at the base; and this is by no means unusually large for the trees of this species. The Rev. Mr. Ewing describes a Swamp Gum tree 102 ft. in circumference at 3 ft. from the ground. For the 1851 Exhibition the exhibitors of the above and other species, had hoped to have procured a plank of the *E. globulus* from the river Deep 14 ft. wide, but were unable to do so for want of saws of sufficient size.

A species called *Tuart* is abundant on the west coast; a plank of it has been seen more than 3 ft. wide, and planks 10 ft. wide may be obtained. Another, called *Jarrah*, said to withstand the attacks of the white ant, and the teredo, etc., has given planks 8 ft. wide. This is perhaps the *E. resinifera* or Red Gum tree.

A third, called *Morrell*, is excellent for trenails and for cabinet work; this attains a diameter of more than 3 ft., and is met with about sixty miles from the shore.

E. robusta, Stringy Bark of Van Diemen's Land, is very abundant. A specimen on the north-west coast, near the Cam river, measures 200 ft. to the first limb, and has been calculated to contain in the trunk above 225 tons of timber. The wood is rather coarser than that of the Blue Gum, and is chiefly used for house and ship building and for fencing: it is also esteemed for trenails. 71.

It is stated that no trees in the world so constantly or rapidly arrive at gigantic dimensions: that they often become hollow, affording roomy places for shelter to the traveller at night; at Moreton Bay one, hollow, was found used by the natives as a cemetery: and that it is almost certain that this genus might be naturalized in Devonshire, Cornwall, and the west of Ireland. 14.

EUCCHARISTIC WINDOW. The term originally proposed by STREET, in the *Ecclesiologist Journal*, 1848, ix, 113, for the opening called HAGIOSCOPE or LYCHNOSCOPE.

EUCTERIUM (Gr. οἶκος εὐκτήριος, εὐκτήριον, προσεκτήριον). These words frequently occur, as meaning a church, in EUSEBIUS, SOCRATES, SOZOMEN, and other ecclesiastical writers; but in some canons and other cases the name seems to be restricted to a domestic chapel. BINGHAM, *Origines*, 8vo., London, 1840, ii, 342, 359, 369, 387.

EUERGANEÆ TRABES. A word applied by VITRUVIUS, v, 1, to certain beams in his basilica at Fanum. BALDIUS derives the word from the Gr. εὐεργής, 'well worked'. CESARIANUS interprets it clamped or keyed together, but without giving any authority; MARQUEZ calls the word 'everganeus', and derives it from the Latin *evergere*, to project, to hang over; and considers it to imply a sort of tassel to the tiebeams; other commentators, who imagine that the basilica in question had a vaulted ceiling, adopt a similar absurd meaning for this obscure term. It is probable that the timbers alluded to were in sight, and therefore, like those in ancient and modern open timber roofs, had their surfaces wrought: if this conjecture be correct, the technical translation would be 'timber wrought framed.' A.A.

EUFRONIUS or EUPHRONIUS is recorded by S. GEORGIUS GREG. TURON., *Hist. Franc.*, ii, 15, as the 'edificator' of the church of S. Symphorim while a presbyter at Autun, where he was afterwards bishop.

EUGENIA pimenta, the pimento of the West Indies, supplies a hard, tough, and durable wood. *E. ferruginea*, called *Viriji* in Cuba, is a hard wood. 71.

EUPOLEMUS. The heræum or temple to Juno near Mycenæ was burnt B.C. 423 according to THUCYDIDES, iv, 133; it

was afterwards seen entire by PAUSANIAS, who, ii, 17, leaves the reader uncertain whether this Eupolemus of Argos was the architect of the original edifice; of a restoration after the fire; or of a new structure, as was probably the case.

EURIPUS (Gr. εὐρύπος, a narrow strait of the sea). A word applied to a ditch round the arena of an amphitheatre or a circus to prevent animals from attacking the spectators. This was first made by Julius Cæsar, on the occasion of exhibiting some elephants, and was abolished by Nero; SURENIUS, in v. *Cæsar*, 39; PLINY, *H. N.*, viii, 7.

At Treves a channel to the form of an area drain, and from 36 to 48 ins. in width and in depth, runs round the circumference of the arena of the amphitheatre. CASSAS, *Voyage, etc., de l'Istrie*, fol., Paris, 1802, pl. 15, shows a double wall, which he calls an open channel, around the arena to the amphitheatre at Pola.

Admitting the existence of a small drain in many an amphitheatre and circus, DE CAUMONT, *Cours*, 8vo., Paris, 1838, iii, 499, considers that if the euripus ever existed in the amphitheatres of Italy, it was not used in those of Gaul; and p. 375, asserts that the euripus existed, in more than one circus, as a canal about 10 ft. wide, bordered by a railing on the side next the arena.

The name would seem to have been afterwards transferred, not to the spina or wall which ran down the centre of a circus, as supposed by some lexicographers, but to the wall of the railing just mentioned, or to the bank of the canal; thus PLINY jun., *Ep.*, i, 3, calls it 'viridis et gemmeus'; and TERTULLIAN, *Adv. Hermogenem*, xxxi, mentions 'statuæ super euripum'; which should be compared with the two places in which the term is used by SIDONIUS APOLLINARIS, *Carm.*, xxii, and xxiii, who evidently concurs with CASSIODORUS, *Ep.*, iii, 51, who says 'maris vitrei reddit imaginem'. AMPHITHEATRE; ARENA; CIRCUS.

EURTHMY. An improper mode of writing EURYTHMY.

EUROMUS in Asia Minor, see JACKLY.

EURYALUS, as he is called by PLINY, vii, 57 (the Agrolas of PAUSANIAS), with Hyperbius, migrated from Sicily to Acarnania, dwelt outside the arx which they built at Athens, and was the traditional inventor of houses and brick kilns.

EURYBIA argophylla, Musk wood. A small tree of Van Diemen's Land, only growing in dense forests and damp situations. The wood is close grained, very beautifully marked, especially at the lower part, and taking a fine polish, is admirably adapted for cabinet work. 71.

EURYCLES (Gr. Εὐρύκλης), not Eurycles as in NAGLER who considers him an architect, is mentioned by PAUSANIAS, ii, 3, as a Spartan who ἐποίησε the most magnificent of the baths at Corinth: whether the verb here means 'designed', or 'built at his own expense', is uncertain.

EURYTHMY (Gr. εὐ well, and ρυθμός a regular and pleasing cadence in music, or poetry, or as some of the old Glossaries have it, a measure or modulus). The word is used by VITRUVIUS, i, 2, as the first subdivision of δικονομήλια. He says "eurythmy is the pleasing appearance (venusta species) and fitting aspect in the composition of the parts (membrorum) of a work. This is effected when the members are in proper relation (convenientia) to each other, as the breadth to the height, the width to the length, and all correspond to the sum (summa, or it may mean height) of its symmetry." He afterwards defines *symmetry* as a fitting proportion in the parts of the members of a work, just as he says in the human figure the finger, hand, forearm, etc., all bear a definite proportion to each other. The probability is, therefore, by *membra* he means the masses or component parts of a design; by *eurythmy* the disposition and method of combination of such masses; and by *symmetry* the relative proportion of the details to each other and to the masses. DISPOSITIO; DECOR; SYMMETRY; etc. *Detached Essay*, ELEMENTS OF DESIGN. A. A.

EUSTOCHIUS (EUSTACHE in RAMÉE, *Manuel*, 12mo., Paris, 1843, ii, 113) the 'edificator' of the church of SS. Gervais and Protase at Tours, where he was bishop, is so noticed by S. GEORGIUS GREG. TURON., *Hist. Franc.*, x, 31.

EUSTYLE. This word, derived through the Latin *eustylus*, from the Gr. εὐ well, and στύλος column, is explained by VITRUVIUS, iii, 2, as the species of temple which has its columns arranged at intervals of two and a quarter of their own diameter, except the central space in front and rear, which is to have the width of three such diameters. He adds the mode of applying a diameter as the measure for dividing the proposed frontage according to the number intended of columns; and by stating that these columns would be eight and a half diameters high he evidently intends only to apply his rule in the case of an Ionic order.

EUTERPE. The name of a genus of palms, inhabiting the West Indies, Mexico, and South America, and furnishing a straight cylindrical stem from 60 to 80 ft. high, and about 4 ins. in diameter when procured from the Euterpe oleracea or *Assai* of the city of Pará; the trees are generally considered too valuable to be cut down for poles and rafters, though sometimes so used. WALLACE, *Palm Trees*, 8vo., London, 1853, p. 23.

EVANGELIUM. This term is given by SCHAYES, *History*, 12mo., Brussels, 1850, i, 70, to the apse or recess upon the left hand of a spectator looking from the nave towards the altar; and he says that, as equivalent to diaconicum minus, the word should be translated sacristy, library, or charter-room; this is open to some objection. He also calls a similar but southern recess 'secretarium'; but PAULINUS NOLANUS, *Ep. xii ad Sever.*, 8vo., Antwerp, 1622, p. 154, shows that although both had that name, the southern or right-hand recess was probably the diaconicum bematis, sceuophylacium, or sacristy. BINGHAM, *Origines*, 8vo., London, 1840, ii, 458.

EVAPORATION (It. *evaporazione*; Sp. *evaporacion*; Fr. *évaporation*; Ger. *verdunstung*). The conversion of water from a fluid state to that of vapour or of invisible gas. The portion of the subject that is most directly important to architects, is that connected with the evaporation from the surface of the ground, and from the materials themselves employed in the construction of buildings. The evaporation from free water surfaces enters more correctly into the study of meteorology.

The amount of vapour which rises from the surface of the earth is regulated by the temperature, the rate of motion, and the previous degree of saturation of the air with vapour from other sources; and by the difference in the tension of the vapour furnished by the evaporating surface, and that of the vapour already present in the air. DALTON, indeed, shows that the quantity of vapour which may be given off in a given time is proportional to this difference of tension; and in perfectly dry air at 50° Fahr. as much water will be evaporated from a given surface as would be evaporated at a temperature of 100° in moist air containing vapour of 0.78 in. tension. The evaporation from the earth takes place at all temperatures, even below freezing point; and it produces a depression of the thermometer in consequence of the absorption of latent heat in the vapour itself. Theoretically, the salts contained in the earth would influence the rate of evaporation; but the disturbing action of this cause is so small that it may be neglected in practice.

It follows from these remarks, that the appreciable amount of evaporation necessary to be considered in building operations, will be regulated mainly by the area of the exposed surfaces, and by the conditions under which the moisture of those surfaces is renewed; whilst the deposition of the moisture so evaporated will depend upon the temperatures of the air, and of the surrounding bodies. The ground, and building materials, as a general rule, are bad conductors of heat; but they have very variable powers of capillarity, and thus the rate of evaporation may frequently be affected by causes of a very complicated nature. So long as the zone of earth under, or

immediately around, a building, which zone is able to absorb water by its capillarity from external sources, may contain any moisture, evaporation will be likely to take place; and it therefore follows that a building cannot be kept permanently dry, or evaporation from it cannot be prevented, unless the transmission of ground damp be intercepted. This must be effected by establishing all round the building either a dry area, or an efficient system of subsoil drainage, for the purpose of cutting off the passage of the earth damp laterally; and by executing the basement courses of such materials and at such depths as shall isolate the surface they enclose, as well as intercept the upward passage of moisture in the walls themselves, through the capillary action of their materials. In the usual practice of English architects, the latter object is attained either by making the basement courses impermeable, or by inserting at a short distance from the surface of the ground a layer of some substance, such as slate bedded in cement, or asphalt, in order to prevent damp from rising in the wall. The passage of atmospheric moisture from the outside to the interior of walls in elevation—one of the most dangerous sources of evaporation in dwellings—is only to be prevented by the use of impermeable materials, or at any rate by making the walls sufficiently thick to prevent the passage of such moisture. Perhaps it may be worth while here to observe that capillarity seems to act vertically in the most distinct manner, and that the inherent moisture of building materials, such as the quarry damp, does not easily communicate itself laterally.

Of course all newly executed works, whether of stone, brick, or plaster, must give rise to a certain amount of evaporation, in consequence of the water those materials may contain in excess of the quantity required to ensure the crystallization of the various artificial cements. It is in fact necessary, in order to slack limes or cements with the rapidity required to meet the demands of our modern habits, to use a quantity of water far greater than that necessary to ensure the rigorous fulfilment of the laws of solidification of those materials; and it is consequently found that after a short interval from the period of the first setting of limes and cements, the surface will be covered with moisture actually thrown out from the interior of the work, an action which is known amongst workmen by the phrase of 'the sweating of the walls'. This moisture must then be either removed by mechanical means, or it must be evaporated, before the building in which it occurs can be considered habitable; but, unlike the case of the moisture from the ground, when once this inchoate source of the supply of evaporation has been removed, the evil arising from it entirely ceases. As a general rule, it is not desirable to hurry the completion of this description of evaporation, for the stability of the new combinations depends greatly upon the manner in which the gradual hydration of the new compound *gangués* are formed. Nevertheless, it is evident that it must be desirable to maintain the evaporation from this cause within the smallest possible limits; and therefore care should be taken in the preparation of the various limes, cements, and plastering coats especially, only to use the smallest possible quantities of water; and precautions should be taken to ensure the complete evaporation of the moisture thus furnished before any attempts are made to cover either the internal or the external surfaces of the building by means of impermeable protecting coats of oil paint, or of any analogous process. The rate at which various limes and cements develop this power of sustaining evaporation depends on the energy with which they 'set'; and it thus happens that the evaporation from a well built wall, wherein the natural cements only are used, will cease long before that evaporation which is supplied by a wall built and rendered with the ordinary kinds of rich or chalk lime.

One of the most serious practical inconveniences attending the evaporation of moisture from walls, especially when that evaporation is constantly renewed, is to be found in the deve-

lopment it is almost sure to give to the 'saltpetreing' of the materials employed. This action may in fact be observed to take place to a slight extent upon the face of all newly executed work, so long as the evaporation from the materials continues. But if the walls should be likely to be able to take up water, by reason of their capillary action, from external sources, the development of the saltpetreing action would progress *pari passu* with the extension of the zone contributing to the evaporation. It seems that this zone rises higher, and that the effects produced by the evaporation are far more dangerous on the interior, or on the northern faces of walls; or, in other words, that the absence of direct sunlight, although it may be opposed to the rapidity of evaporation, has a decided influence upon the manner of its action. It may also happen that the very impermeability of a building material, if it be combined with energetic conducting powers of heat, may at times contribute to entertain a species of evaporation; because the moisture, which is condensed upon its face, can under such circumstances only be removed (naturally) in that manner; and it is on account of the absorption of heat, which accompanies the evaporation, that this process becomes one of the most serious reasons against the use of non-absorbent, good conducting materials, such as marbles, granites, etc., in halls, lobbies, vestibules, or other rooms wherein atmospheric moisture may have ready access. In warm climates these laws of the conducting and evaporating powers of materials are occasionally applied for the purpose of maintaining a desired state of temperature. Even in this case, however, it is essential that the rate of evaporation should be entirely under control; and in colder climates every action of this description should be effectually destroyed before the buildings in which it might take place are used for the purposes of habitation. CAPILLARY ATTRACTION; CONDENSATION; DAMP; DRY AREA; DRYING CLOSET; EFFLORESCENCE; QUARRY DAMP.

G. R. B.

EVERDINGE, see EWERDLINGEN.

EVESHAM (HENRY OF). Extracts given by LELAND, *Collect.*, 8vo., Lond., 1770, i, 249, state that this Henry, under the abbot John de Brokehampton 'artificiose composuit' the chapter house that was finished 1317 and which for its size and beauty was reckoned amongst the chief apartments of the kind in England, the dormitory, the refectory, the abbot's hall, and the kitchen, to the Benedictine abbey at Evesham in Worcestershire. He died 1319.

EVORA (the Latin *Ebora*, perhaps *Ebura*, and *Liberalitas Julia*). A city in the province of Alemtejo in Portugal. Its ruined walls, citadel, and two forts, as well as the old and badly built houses that line the narrow and winding streets, render it rather picturesque, and it counts among the four interesting cities in the kingdom. The leading objects of attraction are the Roman antiquities, unrivalled in the Peninsula, and consisting of an aqueduct (restored 1521-57) with its castellum (*Detached Essays*, AQUEDUCT, p. 17), and an architrave carried by ten columns, each having sixteen flutes, that has belonged to a hexastyle pycnostyle edifice of the Corinthian order, each column being 3 ft. 4 ins. in diameter. These are given in MURPHY, *Travels*, 4to., Lond., 1795, p. 303, together with a *casa dos osos*, 'golgotha', or bone-house of the Franciscan monastery, where the walls and the eight piers, carrying the vault that is 66 ft. long by 36 ft. wide, are lined with skulls. The cathedral, commenced 1186, consecrated 1204, and restored 1283, had its choir rebuilt 1721 by F. Ludovici: the see was made archiepiscopal 1541. The only other edifice of importance is the church of S. Francisco, founded 1481-91, and completed 1495-1521. FONSECA, *Evora Gloriosa*, fol., Rome, 1728, has founded that book upon a manuscript at Evora in four volumes, by the Jesuit Emmanuel Fialho, before 1720. RACZYNSKI, *Dict. Art.*, 8vo., Paris, 1847, s. v.

EVORA (FERNANDO D'), nephew of Martin Vasquez (who died 1448) is cited as master of the works at Batalha in documents dated 1448-73. He was succeeded at his

death, which occurred before 1477, by a master named Guilherme.

EVREUX. A city, in the department of the Eure in France. It consists of narrow streets formed by well built houses, amongst which are several exhibiting timber framing of various dates from about the middle of the fourteenth century. Bishop Gisbertus (1070-1112) officiated at the consecration 1076 of the cathedral, 'quam ipse perfecit' according to ORDERICUS VITALIS, v, and xi, who, xii, and xiii, shows that the church was burnt 1119, and that bishop Audin (1115-39) 'a fundamentis reparavit' the edifice. RAMÉE, *Hist.*, 12mo., Paris, 1849, ii, 201, and GAILHARAU, *Monuments*, fol., Paris, 1850, iv (who gives three plates of the screens to the chapels), seem to have fallen into several errors as to names and dates respecting the period 1194-1256, as appears from their best authority, the GALLIA CHRISTIANA, xi, 596-611, which showing that bishop Gaufridus Faé, 1340, 'auxit et ampliavit fabricam —et precipuè chorum', states that the cathedral, episcopal palace, and greater part of the city, were destroyed by fire 1355; but it also appears that though the dean and most of the canons retired to Vernon, four of the latter remained to officiate in the cathedral. Besides this last fact, four of the painted windows commemorating bishop Geoffroi Faé exist nearly intact, while the interment 1374 of bishop Robert de Brucour at the high altar, and a donation 1376 towards the renewal of the stalls in the choir, render it probable that the injury, whatever that might have been, chiefly occurred to the nave, where the window given by bishop Guillaume de Cantiers (1400-18) is still in good preservation: it also appears that the repairs were continued under bishop Martial Fournier (1427-39), as is corroborated by the Second Pointed character of the triforium and clearstory to this nave, which is only 21 ft. wide between the pillars; the choir is 33 ft. in width between the central pillars; the whole length is about 368 ft. 6 ins. externally inclusive of the Lady chapel; the nave is 155 ft. 6 ins. long, and the side aisles are about 12 ft. wide; the spaces between the flying buttresses are filled by chapels: the transept is 112 ft. long and 23 ft. wide; according to the dimensions and plan given in WINKLES, *French Cathedrals*, 4to., London, 1837. Cardinal Jean de Baluc (1464-7) commenced the addition of the south transept, the lantern and spire over the crossing, 'tholum, pinnaculum', the sacristy, the Lady chapel, the library, part of the cloister, and several buttresses to the east portion of the structure. Bishop Gabriel le Veneur (1531-74) constructed several chapels, repaired the building damaged by fire to such an extent, inclusive of reconstructing the outer walls of the aisles, that the building was reconsecrated 19 March 1547, and 'ornavit', supplied the decoration of the almost rebuilt front of the north transept, "the most perfect, beautiful, and consistent specimen of its class", i.e. of Flamboyant art, as it is called by INKERSLEY, *Inquiry*, 8vo., London, 1850, 338-49. WHEWELL, *Architectural Notes*, 8vo., Cambridge, 1835, p. 176, states that the nave in its lower part is Romanesque, while the triforium and clearstory, with the choir, belong to the period of Geometric tracery, and notices that the interior ends of the transept are quite models in their way, and the octagon lantern is set on the square crossing in a very elegant and artist-like manner. Of the exterior of the north transept, he says the flanking towers are very rich, without outshining the space flanked by them, and being terminated by very graceful clusters of canopies and pinnacles, this front appears to have succeeded in attaining that uniform richness and elegance at which the south front of Beauvais has aimed and failed. The same author also suggests the series of wooden screens to the chapels surrounding the choir as examples of the disappearance of the Flamboyant into the revived Italian styles; but considers the two towers of the west front as Gothic conceptions expressed in classical phases; the northern bell tower may have had its foundation 1352, its completion 1417, and its dome 1531-74, to which date the south tower is perhaps referrible. A view of these towers and of the central

spire is given in CHAPUX, *France Monumentale*: a view and details of the north front occur in the MOYEN AGE MONUMENTALE, pl. 30, 155, 171-2, 392, 407. The northern tower is attributed, in the records of the chapter, to a chapelain de la cathédrale, the abbé Martin, at the close of the seventeenth century.

The monastery of S. Taurin, once Benedictine, was constructed about 1026; the Romanesque arcade on the outside of the south transept, filled in with fret-work of blue slate and red brick, not cement as generally stated, existing 1035, burnt 1194, is described by INKERSLEY, 157-9; and part of the cloister (Renaissance work), with the very good well in the parvis Notre Dame, the court of the old archiepiscopal palace, and the tour du gros horloge or de beffroi (dating 1417), are given in TAYLOR and NODIER, *Voy. Pitt.* (Normandie), fol., Paris, 1825, ii, 225-8; and this octagonal beffroi, with its staircase turret, open bell story, and small spire of Flamboyant work, is shown in SOMMERARD, *Les Arts au Moyen Age* (Album), ii, 5. The episcopal palace was erected 1484. The west front of the church of S. Giles, if still existing, has been cited as a good example of early Romanesque work. The vestiges of ancient works, consisting of baths, a large theatre, and a supposed temple, in the vicinity of this city, the Mediolanum or Civitas Ebroiconum of the Romans, have been described by REVER, *Mémoire sur les Ruines du Viel-Evreux*, 8vo., Evreux, 1827; and by BONNIN, *Hist. de la Ville*, 1623-1816, 8vo., Evreux, 1817; and *Antiq. Gallo-Romaines des Eburoviques*, etc., 4to., 1860.

EWERDLINGEN or EVERDINGEN (ANDREAS VON) is a baumeister whose name occurs 1412 in the list of architects to the dom at Cologne, where he probably worked until the engagement 1433 of Nikolaus von Buere. *BAUZEITUNG*, 1843, viii, 42.

EXAMPLE, see PATTERN.

EXASTYLE, properly HEXASTYLE.

EXCAVATION (It. *scavazione*; Sp. *desmonte*; Fr. *déblai*; Ger. *aushöhlung*). In building operations, the removal of the earth which forms the natural surface of the ground intended to receive the foundations of a structure, or the materials of an artificial water-course, roadway, or other analogous work, is usually known by the name of *excavating* when it is performed in the open air, or by the name of *mining* when it is entirely subterranean. Architects are more immediately connected with this class of operations in the formation of foundations, basement stories, and cellars, or of approach roads, terrace gardens, etc.

The mode of executing works of this description, and the tools employed, vary naturally with the character of the soil to be operated upon; and it also follows from the same reason that the price may vary within a very wide range. Another important element of the price of excavating is the depth to or from which it may be necessary to cast the materials removed; and it is on this account that, in the ordinary tariffs of builders' work, the prices are fixed to the different descriptions of excavation; 1, with regard to the nature of the material; and 2, with regard to the depth of the excavation itself.

1. The different kinds of earth, ordinarily met with in the course of excavations may be defined, as being *a*, those which may be moved by the spade or tool, such as light sand, clay, small broken stones, etc.; *b*, those which require the use of the pick and the spade; *c*, those which cannot be removed without the use of crowbars, as well as of the pick and spade, the former being represented by the gravels, the latter by the shattered upper strata of ordinary rocks; and *d*, the materials which it may be necessary to blast, to lift with wedges, or to attack by some of the ordinary processes of quarrying. Of course it would be dangerous to affix any invariable prices to these respective descriptions of work, because the local rate of wages, and even local varieties in the composition of the rocks or earths, may materially affect their value. As a rough general rule, however, the prices ordinarily paid for excavating in the

substances included under class *a*, range between $3\frac{1}{2}d.$ to $5d.$ per yard cube; for those under class *b*, the range is between $7\frac{1}{2}d.$ to $10d.$ per yard; for those under class *c*, between $14d.$ to $17d.$ per yard; and for those under class *d*, between $2s.$ to $2s. 6d.$ per yard. In all these cases it must be understood that the price affixed is only for getting and filling at once into barrows or waggons, or for throwing upon the bank to a height not exceeding 6 ft. from the bottom of the cutting. When the materials are transported to any distance, for the purpose of forming an embankment, etc., the transport gives rise to an additional charge, which has been already alluded to under EARTHWORK.

2. The depth of an excavation affects the price, because when it exceeds six feet the workmen at the bottom of the cutting cannot throw the stuff they raise upon the bank, and they are therefore obliged to erect an intermediate stage upon which it is thrown, to be there again taken up and delivered to a second class of fillers or dressers, working at the higher level. Every additional stage, in fact, increases the cost of the work at the rate of at least $1d.$ per yard cube; and it is to be observed that in narrow cuttings the number of the stages and the increased cost become greater than would be the case in wider ones, for the simple reason that as the workmen cannot cast the stuff from them freely, they cannot throw it so far. The distance apart of the stages may even descend to as little as 4 ft. 6 ins. It also generally speaking is the case that it is necessary in narrow cuttings (as for drains, sewers, etc.) to strut or stay the soil; and this operation not only gives rise to an additional outlay on account of the shoring, but it also renders the extraction of the materials more difficult. In some cases it may be necessary to remove the earth by means of a windlass and buckets, as is frequently adopted in excavating for sewers, etc.; and in wide cuttings, inclined planes for carts are formed, to be filled at once from the bottom.

As it is possible that in the course of an architect's practice he may be called upon to execute drains or sewers in tunnel, it may be well to notice that the minimum size of the galleries in which a man can work is about 3 ft. high by 3 ft. wide when in rock; and that in clay such galleries should be made 4 ft. high by 2 ft. 6 ins. wide: the materials excavated from such galleries would be removed by means of buckets or corfes and windlasses. When drains are formed in the open ground, or pipe sewers are laid, the width of the bottom of the trench must be wide enough for the workman to stand easily, or about 14 ins. if the depth be great, or 9 ins. if it should not exceed 5 ft.; the width at the top must be at least 21 ins. The various questions connected with *slips*, *running sands*, and *mining*, in so far as it relates to the execution of *tunnels*, or of large earthworks, will be treated under those heads.

A Practical Inquiry into the Laws of Excav., etc., by a Resident Assistant Engineer, 8vo., London, 1840, is severely criticized in the *Civil Engineer Journal*, 1841, iv, 27; SIBLEY and RUTHERFORD, BIDDER, BASHFORTH, and MACNEILL, have each published *Tables showing the Contents of Excavations*, etc.; BRUNTON, *Excavating Ground and Forming Embankments for Railways*, etc., 8vo., London, 1836. CAVASION; EARTH; EARTHWORK; EMBANKMENT. G. R. B.

EXCAVATING MACHINERY. Attempts have recently been made to reduce the cost of earthwork by applying to them modifications of the more ordinary descriptions of machinery; but the success which has attended those attempts has certainly not been such as was to be desired, except in the case of raising materials from the beds of rivers, etc.

The tools commonly used for detaching masses of rock are picks, wedges, bars or levers, and jumpers; and these tools operate by their shock, or by the leverage exercised upon them. Occasionally gunpowder is used to detach very hard rocks, the holes to receive the charges being bored by means of jumpers, drills, or even by the use of acids—a system which has recently been improved by M. Courbebaie, who first bores the holes as usual, and then enlarges the bottom of them into

species of chambers by means of hydrochloric acid (*Annales des Ponts et Chaussées*, cahier 2, 1855); this process it is to be observed is only applicable to the calcareous rocks, and fluoric acid might very probably be useful in the case of the sandstones, the granites, whinstones, basalts, etc. In all these operations, however, the materials are only detached one from another, and reduced into minute fragments, to be subsequently lifted into the barrows, carts, etc.

There are several mechanical appliances employed in large removals of earth, which are valuable although not considered to rank amongst 'excavating machines'. The first is the *horse run*, by which the workman, who guides the barrow filled at the lower level of the excavation, is assisted in raising the barrow up an incline. The second is the *steam lift*, by which the cases containing the excavated materials may be lifted vertically, or may be hauled up an inclined road. In some cases hydraulic cranes have been used for hoisting loads; and indeed, as the object is simply that of lifting a given weight to a given height, the choice of the system of machinery must be regulated by local considerations of economy in working it.

In hydraulic operations, machines, used for the purpose of raising earth from below the surface of the water, are known as *dredging engines*. They consist principally of *spoon dredgers*, or sharp edged iron frames with a leathern bag fastened to the end of long poles worked either by hand or by winches, which are used to raise sand, mud, or small loose shingle from a depth of between 6 and 14 ft., though at the latter depth the economical results they give are not satisfactory; or they consist of *steam dredgers*, in which an endless Vaucanson chain, bearing a series of buckets, is made to revolve by means of a steam engine, over the ground to be removed; the buckets having a sharp cutting edge detach the ground, and raise it to a shoot, from whence it falls into the barges; the dip of the buckets is regulated by a crane on the deck of the engine boat. The depth from which these steam dredgers can economically raise earth is from between 15 to 20 ft.; and it may suffice to add that an engine of 16-horse power will raise about two hundred yards cube per day from a depth of 14 ft. at an expense of about $1d.$ per yard cube delivered into the barge. The steam dredger does not usually work well with a less depth than 12 ft. of water unless specially constructed for the place to be operated upon.

A modification of the steam dredger has been applied upon land, under the name of the *American excavator*, an account of which will be found in the Minutes of Proceedings of Inst. of Civil Engineers, 1845, iv, 399. In practice, however, it has been ascertained that the useful results of the steam excavator depend entirely upon its being applied to remove an earth of an uniform degree of resistance; for directly the bucket meets with material of a harder character than that it was originally intended to overcome, the increased resistance is likely to break the driving gearing. The same remark applies to a great extent in the case of the steam dredger, which cannot be applied to raising any but those of uniform character, such as mud, clay, sand, and gravel. If either the dredger or the excavator encounters rock, the machine is likely to meet with serious injury; the use of the steam excavator has therefore been almost entirely abandoned in Europe, whilst the dredger is only employed to remove the softer descriptions of material.

Great attention has lately been directed to the boring machinery used for perforating Mont Cenis; and, strictly speaking, it may be considered to rank amongst excavating machines. The first boring engines used in this bold undertaking (the length of the tunnel as designed being 13,670 yards) were invented by M. Maus, and they consisted of a series of borers, or rather horizontal jumpers, set in motion by water wheels at either end of the work. Subsequently Messrs. Colladon, Bartlett, and Sommeiller and Co., introduced modifications in the motive power, which is now derived from the intermitting expansion of air compressed to about six atmospheres acting

upon the pistons of the boring tools. The compression is effected by some waterfalls near the mouths of the tunnel; and, in its escape, the air serves to ventilate the mine. The inventors of this engine calculate that they will be able to advance at the rate of ten feet per day at either end; so that even if they achieve all they anticipate, at least from six to seven years will be required for the execution of this tunnel. No recent accounts of its progress have been published, nor have any statements of the performances of the engine been issued. One of the greatest difficulties attending the execution of the Mont Cenis tunnel arises from the fact that the mountain above it is of such an enormous height that it is impossible to sink shafts, or to commence the work in more than two places. In ordinary tunnels shafts are used, and the materials thus extracted by mining are raised to bank by means of horse gins, or hoisting machines, moved by horses; very little other machinery is used in these operations.

A description of a French machine is given in the *CIVIL ENGINEER Journal*, 1839, ii, 468; iv, 233. An account of Messrs. Carmichael, Fairbanks, and Co.'s American excavating machine is described by NEWTON, in the *Transactions of the Society for the Encouragement of Arts, etc.*, 8vo., London, 1841, liv, p. 167, which states the consumption of fuel at 1.55 lbs. of coke per cubic yard of stiff clay excavated at Brentwood in twelve hours. Rickett's digging machine, consisting of a locomotive engine and boiler, is described in *BUILDER Journal*, 1858, xvi, 522. An American steam excavating machine, by Ottis of New York, is illustrated in the *CIVIL ENGINEER Journal*, 1843, vi, 147, 268. Ellwood Morris, of the United States, has given in the *AMERICAN FRANKLIN Journal*, 1841, the cost of excavating earth by means of scoops, reprinted in *CIVIL ENGINEER Journal*, iv, 416-8.

EXCHANGE (It. *borsa*; Sp. *bolsa*; Fr. *bourse*; Ger. *börse*). As soon as the wealthy members of a civilized community become aware that their residences, offices, counting houses, or shops, are so far apart, that business is hindered by the delay consequent upon a necessity for seeking each other, they agree upon some place at which their presence during fixed hours for the transaction of business may be expected. Whether the locality be a portion of a street, or a public place, or a quay, the natural sense of mankind has generally planted it with trees, or has provided some artificial shelter: at London and at Seville the bill-brokers frequented the cathedrals until the erection of the exchanges. Here daily intelligence affecting the various exchanges is proclaimed; public (as distinguished from municipal) business of the community is discussed; insurers effect business; masters of vessels look for freights; and state loans may be negotiated. For several of these purposes it would be found desirable that apartments for the notary, the broker, the money-changer, and the banker should be attached; the locality or the building thus appropriated being generally termed in England an 'exchange' in consequence of that in London being from the first a place for the negotiation of bills of exchange. From the fact that the upper portion of Sir Thomas Gresham's building was a sort of bazaar, the term was transferred to at least one promenade with shops for the sale of articles of luxury or of dress: the market for stocks, scrip, and shares, had perhaps a reasonable title to carry with it the name upon separation from the original locality; but no good reason occurs for the use of the word in reference to a mere market, as for coals or for corn.

The *agora* of the Greeks and the *forum* with the *basilica* of the Romans are said to have afforded to the classes above described the necessary precinct and shelter, until the disturbances from the retail traffic in the one case and from the legal proceedings in the other drove the merchants and their clients into the porticoes (BRADY, *Ruins*, 12mo., Brunswick, 1854, p. 13, specially attributes this use to the *Schola Xantha* at Rome). Cloistered courts with their conventionally indispensable bellfries in the mediæval towns served the like purpose. At

Toulouse and many other French towns, indeed, the *grande place* was a sufficient place of meeting; and perhaps Lyons and Paris were the only French cities that before the present century had a real exchange. But so early as the fourteenth century the free towns of the North, of Flanders, and of Holland, had localities appropriated to the daily meetings of the merchants, and it soon became customary to inflict a fine for entering after the bell had ceased to ring, and to consider failure or bankruptcy the only reason for absence.

The merchants at Bruges obtained, as their exchange, the hôtel of the noble family named Van den Bourse, whose armorial bearing, three purses, was sculptured over the gate; hence arose, it is stated, the custom of giving the name 'bourse' to edifices having a similar destination; in 1833 considerable alterations were made, but the building still exhibits a great portion of the reconstructions effected about 1473; in 1675 the business was transferred to the hôtel de Bouchute, also in a Pointed style, at the corner of the rue S. Amand. At Antwerp the bourse, founded about the middle of the fifteenth century, still exists in great part just as it was constructed 1515; the new bourse, dating 1531, was about 190 ft. long and 150 ft. wide, with an area about 138 ft. long and 102 ft. wide, shown with the new roof in the *BUILDER Journal*, 1852, x, 321; and, although the city was ruined 1585 in commercial importance by the transfer of its business to Amsterdam, this building had its daily visitors until its destruction by fire 2 August 1858: it was held by SCHAYES, *Hist. de l'Arch.*, 12mo., Brussels, 1850, iv, 60, to have been the model for a plan drawn by Richard (the father of Sir Thomas) Gresham at his visit 1537, and for the somewhat similar edifice constructed 1566 in London by the architect Hendrickx of Antwerp. The first stone of 'Britain's Bourse', attributed by some writers to Inigo Jones, was laid 7 June 1565-6; the building was opened 1567, and it was named the Royal Exchange 23 January 1570-71: this was burnt 4 September 1666; the design by Edward Jerman (not as is sometimes stated by Wren) for its re-erection was approved 21 September 1667; the first stone was laid 23 October 1667, and the edifice was opened 28 September 1669. This building was about 202 ft. long and 168 ft. wide, with an open area 107 ft. 6 ins. long and 74 ft. 6 ins. wide, surrounded by arcades 23 ft. wide; the western side was rebuilt 1767 by W. Robinson; and the whole was restored 1821 by G. Smith, who added the cupola to the south front: an elevation and a view of the area previous to the fire 10 January 1838, are given in BRITTON and PUGIN, *Public Buildings*, 8vo., London, 1835, i, 287; others are given in ANGELL, *Hist. Sketch*, 8vo., London, 1838. The present structure (details of which are given in the *CIVIL ENGINEER Journal*, 1845, viii, 1, 68, and 241; and SURVEYOR, etc., *Journal*, i, 145, 203, 219, and ii, 5) had its first stone laid 17 June 1812, and was opened by Her Majesty Queen Victoria, 28 October 1814, but for business 1 January 1815, having been entirely carried out by W. Tite, F.R.S., at present the representative in Parliament for the city of Bath, who in a paper read at the Royal Institute of British Architects (reported in the *BUILDER Journal*, 1846, iv, 1, and *CIVIL ENGINEER Journal*, 1846, ix, 28, considered that "the appearance of the original building is preserved to us in Hollar's engraving, which shows it to have been in a much better style than the bourse at Antwerp, of which it has been pretended it was a copy. That of Amsterdam bears a much greater resemblance to it, but in this case the London building is the original, and not the copy; that of Amsterdam dated only from 1612." A good though short account of the three Royal Exchanges in London, with views and plans, will be found in *The Pictorial Handbook*, 12mo., London, 1854, p. 373: it is worth noticing that the present area if rectangular would be about 296 ft. 6 ins. long and 150 ft. wide; that the area for merchants is 168 ft. long and 111 ft. wide, of which 116 ft. by 58 ft. are uncovered; and that the cost was only £150,000. The chief business transacted in the area is the negotiation of foreign bills of

exchange: but nearly half the surrounding building is appropriated as 'Lloyd's' to the business of the mercantile marine service of the country.

The exchange at Amsterdam (cited by GWILT, *Encyc.*, § 2939, as seeming "for a long time to have prevailed as the model for all others") occupied a site about 273 ft. long by 153 or 173 ft. wide, as constructed 1608-13 under the architect Hendrick de Keyser by Cornelis Danckaerts de Ry; it has been replaced by a structure commenced 1844. The exchange buildings at Liverpool, designed by John Foster, date 1803-8, and cost £110,848; they form three sides of an open area about 270 ft. long and 135 ft. wide (35,066 square feet), nearly closed on the fourth by the town-hall. The Börse at Hamburg, designed by Forsmann, and illustrated in the *BAUZEITUNG Journal*, 1849, xiv, 287, pl. 290-2, is 226 ft. 6 ins. long by 174 ft. wide externally, having a central covered area with clearstory windows, 124 ft. 6 ins. long by 70 ft. 6 ins. wide; there are three rows of arcades on each side, one row going all round and two more along three sides of the building. According to the very short article in VIOLETT LE DUC, *Dict. s. v. Bourse*, the exchange at Paris seems to have been held amongst the piers of the hôtel de ville: BLONDEL, *Arch. Franç.*, fol., Paris, 1752, iii, 71, gives a plan of the late bourse (the préau or planted court lately remained and perhaps still exists), that was next the palais royal at one end of the rue Grojenne, now Vivienne, which abuts at the other end on the present edifice. This covers a site about 288 ft. long and 164 ft. wide, has a covered *salle* 106 ft. long and 78 ft. wide, and cost about £300,000; the work, commenced 1808 by A. T. Brongniart, and completed after his death 1813 by Labarre, is illustrated by the former in *Plans du Palais de la Bourse*, etc., fol., Paris, 1814; *BUILDER Journal*, 1846, v, 135, extracted from CRESSY, *Encyc.*, 8vo., London, 1847. The bourse at Tournay, in the style of the Renaissance, is a work of the sixteenth century. The loge des changes at Lyon, as executed 1749 from the design of J. G. Soufflot, may be seen in a large engraving by Bellicard. P. Coste has 1860, nearly completed the exchange at Marseilles. The best example of a bourse in the Spanish dominions is said to be that called the casa-longa or 'long-room' at Mallorca, in a Pointed style, attributed to Guillermo Sagrera, 1426-48. A view of that at Palma in Majorca, dating from the fifteenth century, is given in the *MOYEN AGE MON.*, pl. 183. That at Barcelona, dating about 1383, was much altered 1770, and was almost rebuilt 1772 by Juan de Solar, but is still about 266 ft. long and 117 ft. wide, with a hall in a Pointed style about 107 ft. long and 70 ft. wide. The lonja at Seville, which occupies a site about 200 ft. square, was constructed 1585-98 by Juan de Minjares under Juan de Herrera, of whose skill it is considered a fine specimen. The Imperial Exchange at S. Petersburg, situated on the eastern front of the Vassilciostroff, was constructed 1805-11 by Thomas de Thomon, called Tonon by GRANVILLE, *S. Petersburg*, 8vo., London, 1828, ii, 303, who gives a view of the building, and states that it occupies a site about 360 ft. long and 270 ft. wide, with a hall 126 ft. long and 66 ft. wide, which was opened 1816. It is also shown by THOMON, *Recueil*, fol., S. Petersburg, 1806; and by SALLANDROUZE, *Vues*, etc., fol., Paris, 1808.

EXCHEQUER (late Latin, *scaccarium*). The labours of DUCANGE, *Gloss. s. v.*, have not resulted in any satisfactory account of the reason why this name was given to an office for the receipt of taxes, the payment of debts and the settlement of accounts in the principal palaces, castles, and monasteries, and perhaps also in every county town in England. FOSBROKE, *History*, 4to., Gloucester, 1807, i, 203, notices the exchequer or office where the tenants who owed service paid their rents toward the farm of the town. Amongst the present buildings of the university at Durham is the former exchequer of the bishops on the green to the north side of the cathedral. The *contaduría* or exchequer (*Fr. chambre des comptes*) of the chapter at Seville still exists.

ARCH. PUB. SOC.

EXCUBITORIUM. An apartment for the persons who kept watch the whole night, and whose business it was to call up the monks to their nocturnal devotions at the regular hours, according to THORPE, *Cust. Roff.*, fol., London, 1788, p. 171, referring to WILKINS, *Concilia*, fol., London, 1737, ii, 247, who merely shows that two monks before, and one after, matins were always to watch in the church at Canterbury. A wooden gallery lately (or still) remaining in the abbey church at S. Albas, is supposed by BRITTON, *Dict. s. v.*, to have been thus used. It certainly does appear from the *Customale Roffense*, p. 31, that some of the monks continually lay in the church; but none of these authorities justify the assertion by BRITTON, *s. v.*, that this word meant a "guard room, or more particularly an apartment, or gallery, in a church, in which persons kept watch during the night."

EXECUTION. This term is usually applied to the practical embodiment of any project or design, in contradistinction to its original conception and perfection in the mind. Thus the drawing of any proposed edifice or ornament is the execution of it as far as the draughtsman or designer is concerned; the edifice itself is the execution of the architect's design. But as words are frequently used to express cognate varieties of the same idea, execution is frequently applied to excellence of the workmanship and materials, or to constructive skill. G. A.

EXEDRA. A common mode of writing EXHEDRA.

EXEMPLAR, see PATTERN.

EXETER. A city and county, the capital of the county of Devon, in England, situated on the river Exe. Portions of the walls are standing; they were entire in 1769. The castle, called Rougemont, is said to have been built either by William I or II. There are no remains of the keep, but the enclosure walls on the east, south, and west sides are still extant. The assize courts were erected within these walls in 1774. The building is very plain, and faced with Bere stone on the front next the castle yard (*ARCHÆOLOGICAL Journal*, iii, 128). The streets are narrow except the High, Fore, and Queen streets; the two former contain many picturesque gabled houses of timber: the city is lighted with gas. Water works were erected in 1694, the supply being derived from the river close to the city, and the water pumped up by means of a stream wheel; pipes of iron were substituted for those of wood in 1811, four years before that material was so used by the New River Company in London. Entirely new works were erected in 1833 by Mr. Anderton, C.E., the supply still being derived from the Exe, but at a point about two miles and a half from the city. Several arches of the old bridge, built 1250, still remain, those crossing the main stream having been removed on the erection of the new bridge; they have ribs of cut stone with the intervening spaces of rubble work; two of them are pointed, and the others are circular; many being deflected or skewed to the direction of the current. An act for erecting a new bridge and forming a more convenient approach to the city was passed in 1769, and the foundation stone of a new bridge was laid 4 October 1770. This work was commenced under the direction of Mr. Dixon, a London architect, and it continued in progress until January 1775, when an unusually high flood swept away the insufficient foundations: Mr. John Goodwin, who had been an assistant in the former erection, was then selected to carry out the new work. The foundation stone of the first arch was laid 15 July 1776, and LYSONS states that the bridge was opened in 1778. It has three arches, and cost about £20,000. A viaduct of cast iron was erected 1834 by Russel and Brown, having six arches, each 40 ft. span, 24 ft. wide; the total length being 800 ft. There is a ship canal with basin and quay; its length is five miles, breadth of water surface 94 ft., and depth 15 ft. The present is an enlargement of a canal commenced by John Trew in 1563, the earliest known work of this kind with regular pound locks; the width of this early canal was only 16 ft., its depth 3 ft., and its length 9,360 ft. It was lengthened and enlarged at various periods, and lastly by James Green in 1830.

The cathedral stands on the site of the ancient monastery and conventual church of S. Peter, and the latter was converted into his cathedral by Leofric, cir. 1050, but no parts exist of these ancient buildings. A new erection was commenced in 1112, and of this church the two towers forming the arms of the transept are the chief parts now remaining: the building was greatly injured by fire in 1136, the present body of the church therefore dates from about 1270. The lower part of the chapter house and the misericords, fifty-one in number, are however of an earlier date, probably the very commencement of the same century. The earliest portions of the church are the lower part of the Lady chapel, with the adjacent chantries of S. Mary Magdalene and S. Gabriel: portions of the choir aisles, as well as the chantries of S. Andrew and S. James, with the chambers over them, appear to be anterior to 1280: between 1280 and cir. 1291 were executed the upper part of the Lady chapel and its vault; and the *design* at least of the remainder of the church, including the commencement of the four eastern bays of the choir; as also the execution of the bold idea of taking out one of the sides in each of the massive Norman towers and supporting the upper part of these walls on arches; thus the arms of the transept are formed by the towers, an arrangement peculiar to this cathedral, but adopted also in the church of Ottery S. Mary, co. Devon, where the towers are likewise of an earlier date than the nave and chancel. Some authorities state that the eastern end of the choir was erected 1308-26; but the fact, of the towers having been made previously into the arms of the transept, almost demonstrates that the choir was at least commenced earlier, the work evidently, and as usual, having progressed from the east towards the west. There is an evident alteration, however, at the fifth bay from the east end, the piers westwards being considerably larger than the others, and the manner in which the arch moldings are adapted to the unequal size of the piers where the change of work occurs is curious. The choir and nave were completed in 1350, when it is probable that the rood loft was also erected; also the cloister (now destroyed), although not covered in till 1382. The west, or screen, front, of a much later period, is remarkable for the abundance of its sculpture, an account of which is given by C. R. COCKERELL, R.A., in the appendix to his *Iconography of the West Front of Wells Cathedral*, 4to., London, 1851. The eastern window is of later date. The upper part and roof of the chapter house, remarkable for the coloured decorations, are the work of the middle of the fifteenth century. The chantries of S. George and S. Saviour are still later, and bear all the characteristic marks of the decadence of mediæval art. The throne is of oak, rising from the floor to above the springing of the groining; its date has not been ascertained, but it cannot be later than the fourteenth century. The upper story of the north tower is said to have been built between 1478 and 1486 for the reception of the great bell, weighing 12,500 lbs., formerly the second, now the third, largest bell in England. The cathedral was much damaged during the reign of Elizabeth, but was repaired 1662-67 at a cost of £25,000. The Lady chapel was restored in 1822 by John Kendall, who erected the reredos.

The stone of the cathedral is chiefly a sandstone similar to that found at Silcombe near Sidmouth, and other parts of the coast; Bere stone was also extensively used; and the fabric rolls record also the use of stone from Silverton, Wonford, and other places in the neighbourhood, and likewise from Caen. These fabric rolls are preserved in an almost uninterrupted succession for a hundred and sixty years, viz. from 1279 to 1429; some extracts are given in BRITTON, who recites the names of Wm. Foundyng and Wm. Gervys, freemasons employed in 1396-7, the former receiving an annual salary of 26s. 8d.; and of John Wolstan and John Harry, freemasons, in 1427.

The principal internal dimensions are, length of nave from west wall to centre of piers of transept 139 ft. 2 ins.; width be-

tween piers 33 ft. 9 ins.; its height 64 ft. 10 ins.; width of aisles between piers and wall 14 ft. 4 ins.; width of nave and aisles 72 ft.; length of choir from rood screen to reredos 121 ft. 3 ins.; width between piers 33 ft. 7 ins.; its height 63 ft. 10 ins.; width of aisles between piers and wall, south 15 ft. 3 ins., north 14 ft. 8 ins.; width of choir and aisles 72 ft. 7 ins.; length of Lady chapel (in clear of walls and exclusive of ambulatory at back of reredos) 57 ft. 2 ins.; width 26 ft. 2 ins.; its height 40 ft.; length of transepts 139 ft. 2 ins.; their width 28 ft. 6 ins.; total length of church 378 ft. 5 ins.

The bishop's palace, situated on the south side of the cathedral, has remains of thirteenth century work, among which is the chapel. The original fine and large hall with an open roof has been converted into rooms. The palace was altered and restored in 1846, under the auspices of the Ecclesiastical Commissioners. The deanery has a fine room with an open roof, and also a chapel, no longer used as such, and the chantry had also a large hall, now made into small rooms. The other buildings belonging to the dean and chapter are modern, and without architectural character. The vicar's close retains its college hall, but the houses are indifferent.

There are nineteen parish churches, besides one, S. Thomas, on the opposite side of the river, for the most part small, and none of note. The largest is S. Sidwell's, rebuilt in 1812 by — Burgess, except the lower part of the tower, which dates 1605. The earliest in respect of architecture are S. Mary Major's, and S. Mary Arches; the former having a Norman tower and many traces of Early English work; the latter Norman piers and arches. There is also a little Early English work in S. Pancras. Those of S. John and S. Stephen have arches for public thoroughfare called 'bows' under their chancels; the latter has also a small ancient crypt. The most recent one is Allhallows on the Walls, built 1845 by J. Hayward, on the site of the ancient cemetery of S. Bartholomew.

The guildhall was rebuilt 1330, and again 1464; the front, consisting of an arcade of three arches over the pavement of the High-street, together with the room above, was built 1593; the principal room is 62 ft. 6 ins. by 25 ft.: the county prison was almost entirely rebuilt 1853 by J. Hayward, and contains three hundred and four separate cells, besides the debtors' ward, which forms a part of the old gaol: the city prison dates 1819: the royal public rooms, 1820, by — Burgess, has a ball room 92 ft. long, 48 ft. wide, and 40 ft. high, accommodating 600 persons seated: the atheneum, 1835, contains a lecture theatre: the Devon and Exeter hospital, founded 1741, with the Halford wing, 1858, has about two hundred and forty beds: the public baths and washhouses: the workhouse, 1707: S. Thomas' union, 1837: the higher or eastern market, opened 1838; the lower or western market, 1836, by C. Fowler, F.R.I.B.A.: these, with the post office by J. Hayward (Corinthian), opened 1850, comprise the other usual public edifices. Of the many almshouses, S. Anne's and Wynard's have chapels; the most recently built are Atwill's. The grammar school, and the English or blue coat school, were founded by Hugh Crossing in 1623, who purchased the buildings and chapel of the dissolved priory or hospital of S. John, established it is said about 1230. As very few remains of the ancient buildings are found, the existing structures may be said to date from the foundation of the schools; but since 1856 the chapel and grammar school have been restored, and the blue coat school is being rebuilt from a design by David Mackintosh; the Exeter central school, 1858, is by G. Cumming. S. Sidwell's schools, 1854, by E. Ashworth, cost £1,700; a plan and elevation are given in the *CIVIL ENGINEER Journal*, xvii, 460: the diocesan training college, 1853-54, by J. Hayward, accommodates forty pupils, and cost, exclusive of site, £7,000; a plan and elevation are given in the *BUILDER Journal*, xiii, 42.

The modern publications are HEWETT, *A Brief History of the Cathedral*, 2nd edit., 8vo., Exeter, 1859; BRITTON, *History, etc., of Cathedral*, 4to., London, 1827; WINKLE, *Cathedral*

Churches, 4to., London, 1842; OLIVER, *Hist. of Exeter*, 1821; KENDALL, *Elucidation of the Principles of English Arch.*, 8vo., London, 1842; *Transactions of the Exeter Diocesan Architectural Society*, 4to., Exeter, 1842-57.

EXHEDRA or EXEDRA (Gr. *ἐξ* and *ἐδρα*, a seat). In its primitive sense a seat out of doors; a meaning it must have retained in the time of EURIPIDES, *Orestes*, 1431, where the affrighted Phrygian says, Pylades drove them out of the house, some into the stables, and some into the exhedrae. From seats out of doors the meaning seems to have been extended to passages, corridors, colonnades, or porticoes in which were such seats, probably the origin of cloisters; and then the meaning seems to have been transferred to chambers opening out of such colonnades, just as chapter rooms opened out of cloisters in later days. In VITRUVIUS, vii, 9, the exhedra described are evidently open, for he not only calls them so, but says the sun and moon can shine into them; in vi, 5, they are described as covered; and in v, 11, as places leading out of porticoes where philosophers and rhetoricians could debate or harangue. Such spacious halls for conversation and the general purposes of society are evidently intended by CICERO, *De Nat. Deor.*, i, 6, who speaks of cellæ ad colloquendum; and *De Finibus*, v, 6, exhedra is used for the school of philosophy itself, in the same sense as the porch or the academy. From PLUTARCH, *Alcib.*, 17, it has been concluded they were semicircular, and probably niche-headed: x and y in the plan of the baths of Diocletian (*Detached Essay*, BATHS) are considered to be such exhedrae. And in compliance with this generally received opinion the name exhedra has been accepted for a niche-headed seat, intended to contain a number of persons, like one in the street of tombs at some little distance out of the gate of Herculaneum at Pompeii.

A. A.

In later times the word was applied to a great number of things: as to a seat; a throne; to the conchula or secretarium on each side of an apse by MACRI, *Hierolexicon*, 4to., Venice, 1735, s. v. concha; to an apse; to the seat of the bishop, probably because it stood in the apse; to the little chambers in the sides of a church called oratorio or esdra by LUPI, *Dissert.*, i, 37, but cappella by MORONI, *Diz. s. v.*, as the equivalent of the It. *cellotta* and *monistero*; to a secret or private chamber; to an apartment or suite of apartments separated from a palace; to the place of the treasury, etc.: in fact BINGHAM, *Origines*, 8vo., London, 1840, ii, 409 and 429, misunderstanding S. AUGUSTIN, *De Civit. Dei*, xxii, 8, translates exhedra by pulpit or ambo, and by apse; besides adding, p. 461, that exhedrae meant such buildings as were distant from the main body, and yet within the bounds, of the church taken in the largest sense; such as the baptistery, porch, vestry, diaconica, prisons, schools, libraries, etc. AMBO; APSE; CONCHA; PASTA; TRIBUNE.

EXHIBITION BUILDING. An erection for the purpose of displaying collections, formed by private enterprise, of natural objects and works of industry. The buildings thus appropriated are generally light constructions, principally of iron and glass, and of various plans; some with a sort of nave, aisles, transepts, etc., some with large domes, etc. The earliest in this country was in Hyde Park in the year 1851, and had a ridge and furrow roof; but in later buildings of this class a roof of glass carried by large arched ribs is preferred. At Manchester the sides were of galvanized iron lined with woodwork. At Paris the Palais d'Industrie (which is a permanent building) is of stone with an arched roof of glass. A minute description of the one in Hyde Park, which in fact is a type of the others, with full working drawings, etc., was published by DOWNES and COOPER, 4to., London, 1852. Pictorial representations of those at Dublin, Paris, New York, etc., may be found in the contemporary pages of the *BUILDER*, ILLUSTRATED LONDON NEWS, etc.

A. A.

EXHIBITION ROOM. A chamber for shewing objects, either of nature, art, or manufacture, on a smaller scale than

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the building before mentioned. Such apartments of course vary in design in an infinite number of ways, according to the exigencies of site, opportunities of light, etc. The most usual, and the best, are in the form of galleries lighted from the roof. GALLERY; GLYPOTHEK; PINACOTHEK.

A. A.

EXHIFFA. This term is explained by BRITTON, *Dict.*, as "the wall or masonry which supports a staircase", referring to DUCANGE, *Gloss.*, where the word does not appear, s. v.

EXNER (CHRISTIAN FRIEDRICH), born 1718 at Lampertswald, studied at Dresden, where as *hofbauconducteur* he arranged the decorations and illuminations (engraved by Zucchi), for the marriage of the elector Friedrich Christian, and 1766 obtained the title of *landbaumeister* as well as of professor of building in the academy. He had the opportunity of exhibiting his taste in a wing to the *residenz* on the Taschenberg, the electoral buildings in the Plaugasse beyond the Seethor, and the tower of the *kreuzkirche* at Dresden, the *universitätskirche* at Wittenberg, several bridges, etc.

68.

EXOCARPUS CUPRESSIFORMIS. A wood, of Van Diemen's Land, giving good ornamental veneers which are often called 'cherrytree' when used for cabinet work.

71.

EXONARTHEX. This term, derived from the Gr. *ἐξω* and *νάρθηξ*, a porch, is of apparently recent origin: it is not employed by BINGHAM, *Origines*, 8vo., London, 1840, who, ii, 394, speaks of the outer narthex as an ante-temple or vestibule consisting of all the buildings (the atrium with its porticoes) in front of a church. From the original signification of NARTHEX, *ferula*, a reed or straight rod, which does not occur as a name in the threefold division of a church until the beginning of the sixth century, it seems probable that when the word exonarthex was manufactured it was intended only to imply such part of the portico or cloister of the atrium as was in front of the church; or an external lobby forming a continuous porticus, which sometimes had a porch under it, as at the church of SS. Nereo ed Achilleo at Rome: it might also signify the outside colonnade or arcaded vestibule situated within the walls, such as is seen between two ranges of piers in front of the plan of the churches at Arnaea (Cassaba) and Myra, given s. v. BASILICA.

A. A.

EXOSTES (Gr. *ἐξώστης*). This word like 'ekthetes' (Gr. *ἐκθήτης*) has been explained as a BALCONY, but it should be rather rendered a balconied loggia, according to SALMASIUS, commenting upon SPARTIAN, *Hist. Aug.*, 8vo., Leyden, 1671, p. 676, who says 'meniana illa vel solaria quæ in planis tectis structantur, Græcis *ἡλιαστήρια* et *ἡλιαστὴκὰ* et *ἡλιαστάμνοι* dicuntur, *ἐξώστα* etiam dicebantur, Latinis *protecta* et *projecta tecta*.' LABBEUS, *Gloss.*, says *ἐκθήτης*, ὁ *ἐξώστης*, ὁ *ἡλιακός*, *aggrunda*, *menianum*, *projectio*, *projectus*, *suggrunda*.

EXPANSION (It. *dilatazione*; Sp. *expansion*; Fr. *expansion*; Ger. *ausdehnung*). The increase of volume, which takes place in bodies from the action of internal force, is known by the name of *expansion*, in order to distinguish this modification of matter from that produced by the action of external force, which is known by the name of *extension*. Practically, the architect is required to take the laws of expansion into account under three only of their principal conditions; viz. 1, when it takes place in consequence of the molecular arrangements accompanying crystallization; 2, when in consequence of changes of temperature in the bodies considered; and 3, when it takes place in consequence of the absorption of moisture by building materials. The second series of these conditions has already been discussed under DILATATION; the former of them is only of importance on account of the expansions which take place in the mortars, cements, and plasters used in building.

Thus in the use of hydraulic limes it is found that when the clay, which is present in the original limestone from which they are obtained, contains an abnormal excess of silica, the mortars are likely to expand in the process of setting; when, however, the clay contains an excess of alumina, the mortars, on the contrary, contract. Some kinds of Portland cement expand in setting; and the real plaster of Paris is so seriously affected

by it, that especial precautions are taken in that city to obviate any danger from that action. For instance, the custom is to execute the façades of the Parisian houses in large ashlar set in lime mortar, and the party and back walls of coursed rubble masonry set in plaster; and in order to prevent the expansion of the plaster in the cross walls from thrusting out the end ones the builders leave a space, from top to bottom, between the two descriptions of masonry, which is subsequently stopped in when the setting of the plaster is complete. The edges and angles of ceilings and wall renderings of these houses are also left unconnected for a certain length of time, in order to allow the expansion of the plaster to take its full effect. Natural cements, English plasters, Keene's, Parian, Martin's, and other plasters exposed to a second calcination, after having been saturated with certain solutions, do not expand in setting.

It is to be observed that all limes exhibit the phenomenon of expansion, to a greater or less extent, during the period of the absorption of the water required for their solidification and imperfect crystallization. The purer the carbonate of lime in the original limestone, the more decidedly does the caustic lime 'swell in slaking'; and to such an extent is this the case, that the volume of the dry powder, resulting from the slaking of the best chalk lime will be from two and a half to three times that of the original lump of caustic lime. Hydraulic limes, on the contrary, do not swell much in slaking; and it thence becomes a species of *prima facie* evidence in favour of a lime, for exposed walling purposes, when it does not swell in slaking.

A rather curious remark is to be made with respect to the use of the white bricks obtained from the blue lias clays. They contain a very large proportion (sometimes as much as 40 per cent.) of the carbonate of lime diffused through their mass; and in the process of burning this lime becomes simply converted into the caustic state; because, precisely on account of its presence, the burning cannot be carried on at any very high temperature. If, then, these bricks should be used in positions where the caustic limes they contain can take up water, and where the natural expansion of the materials should not be able to take place freely, the walling so executed will inevitably be thrown down. Retaining walls in damp situations, if executed in these white bricks, are liable to this description of accident.

The expansion of timber, in consequence of the absorption of moisture, is a frequent source of annoyance in building operations. It takes place in the direction transversal to the fibre of the wood, not in that of the length, and therein it differs from the dilatation produced by increase of temperature, which acts slightly in the latter direction. The rate of expansion differs, of course, with the porosity and the original state of 'seasoning' the wood may have attained; and hitherto no consecutive series of observations have been made on the subject. BRICKWORK (p. 147); CONGELATION; CONTRACTION; DILATATION; PETERSBURGH PLANK.

G. R. B.

RENNIE, *On the Expansion of Arches of Iron and of Stone Bridges*, given in the *Transactions of the Inst. of Civil Engineers*, 1840, iii, 201; abstract in *CIVIL ENGINEER Journal*, iii, 133. The general allowance for the contraction of cast iron in cooling is 0.01, but the slower the cooling, the greater the contraction, as stated by EDWARDS, in the *CIVIL ENGINEER Journal*, 1842, v, 279, describing the operation of casting the voussoirs 14 ft. 9 ins. long of the pont du Carrousel at Paris: in this case it was found requisite to curve the model itself about three-quarters of an inch in its length, to prevent the tendency of the casting to bend as it cooled, because the outer edges of the flanches cooled faster than the centre part. BRAY, in the same *Journal*, 1845, viii, 286, notices the provision made against the effect of heat in the two leaves, each about 22 ft. wide, of the Ouse bridge on the Hull and Selby railway, where the opening between them is 0.75 of an inch wider in cold frosty weather than during a hot summer.

EXPIATORY CHAPEL. A building erected to expiate a murder or other great crime. A structure of this kind,

erected in the fifteenth century on the centre of the bridge at Bar-sur-Aube, is given in ARNOULD, *Dep. de l'Aube*. An edifice, of a similar character, was erected in Paris about 1825, from the designs of Percier and Fontaine, for the purpose of depositing in it what remains could be collected of Louis XVI; three views are given in PUGIN and HEATH, *Paris and its Environs*, 4to., London, 1831.

EXPRESSIO. A word used by VITRUVIUS, iv, 4, in a passage which has given rise to much controversy; namely, "Idem circum coagmenta et cubacula eminentes expressiones, graphicoteram efficient in aspectu delectationem." The author is speaking of walls of squared stone or marble, and the passage probably may be rendered "And also (surrounded by the beds and heading joints) prominent projections will give a picturesque effect." The work alluded to is probably rusticked, where a sunk channel chamfer surrounds the face of each stone. A. A.

EXPRESSION. This term is frequently used instead of CHARACTER, but its legitimate signification is the indication of the intention of the design. The indication when correctly marked is conveyed by a strict propriety of composition, whether in the general mass or in the details of the ornaments; descending as it were from the one to the other; the purpose of the building being shewn by the prominence and development of those parts of the structure appropriated to its principal objects, and the due subordination of others to its meaning by the judicious application of such accessories of ornamentation as will express this object in its most poetical manner. This will be done by the skillful architect so completely, that the minutest part will assist in its degree as much as the most important features. A thorough appreciation of the idea to be conveyed, with a careful study of the works of the best ages and the most accomplished masters, can alone teach this, one of the most essential points of good architecture. Such indication is chiefly conventional. But still there is a certain amount of expression which is not so, viz. that which tells every spectator that one building is a church, another a prison, another a house, and another a stable. It must be evident that the system of grouping many establishments for different purposes under one roof and behind one façade must be fatal to all delicacy of expression, though a general air of gloom, solemnity, majesty, grandeur, solidity, respectability, gaiety, etc., may be obtained. *CIVIL ENGINEER Journal*, 1843, vi, 36. H. B. G.

EXTENSION (It. *estensione*; Sp. and Fr. *extension*; Ger. *ausstrecken*). The lengthening of a body, by the application of external mechanical forces, is called extension; and this may be either permanent or temporary. Permanent extension takes place when the limit of elasticity of the substance has been exceeded, and it is no longer able to resume its original form on the force being withdrawn. Temporary extension is when the substance returns to its original state; and this, as TREDGOLD observes, is the true measure of resistance of all bodies where flexure is admissible. All bodies are more or less susceptible of extension by increase of temperature, as previously observed *s. v.* DILATATION. Under the action of mechanical forces they seem to be subject to the following simple laws, viz. that the load capable of producing rupture by extension is proportional to the transverse section of the body considered; and that the above load has no reference to the length, provided the texture of the body be homogeneous, and its own weight be taken into account. It has been found, by direct experiment, that the substances which have the highest coefficient of elasticity are also those which resist rupture by extension in the most energetic manner; or, in other words, are those which have the greatest tenacity; glass being among the most elastic substances. ELASTICITY; EXPANSION; RUPTURE.

In building operations, no material should be exposed to strains calculated to produce permanent extension; and precaution must be taken to prevent any interference with the temporary extension produced by changes of temperature, especially upon metals. CONTRACTION. G. R. B.

EXTRA. The amount of an estimate or a tender may be exceeded in four ways; 1, by the ADDITION of new works; 2, by ALTERATION of intended works; 3, by a rise in prices, which is properly an AUGMENTATION; and 4, by the necessity of allowing that the workmen can justly claim payment for labour or materials which ought to have been provided, but which had not been foreseen, by the architect: the term extra properly belongs to this class alone. If the excess of the ultimate cost of any work should exceed the price originally contemplated, many disputes between the architect and the employer might be avoided by a careful classification of the causes of the various items under the appropriate headings above given. A fifth use of the word may be noticed in PASLEY, *Outlines of a Course*, 4to., Chatham, 1826, who, p. 345-55, speaking of the system of doing work upon scheduled prices, says that all extras (*i. e.* works not in the schedule) should be provided for, etc.

EXTRA; EXTRA WORK. Work which may be executed from time to time about a building to make its various parts complete and perfect, but which may have been unintentionally omitted, or are not described in the specification, or shewn in the drawings. In consequence of this omission, the builder urges that he did not put down any sum for them in making his estimate, that he has been obliged to perform them, and therefore in justice should be paid for them.

These works are of two kinds; 1, such as the architect could not foresee, as defective places in the foundations, old wells to fill up, etc.; and in repairs or junction with old work, walls found to be defective when cut into, timbers appearing to be decayed when exposed, etc.; 2, such as have been inadvertently omitted to be described in the specification, etc. A reasonable margin to an architect's estimate ought therefore to be added; some of the best practical architects think 10 per cent. ought to cover all extras of this class. Should there be any doubt as to defects in footings, etc., it is better to provide . . . yards cube of concrete, . . . rods of brickwork, etc., to be used if required, else the whole or part, as the case may be, to be deducted from amount of the builder's contract. Works ordered from time to time during the progress of a building, as more closets, cook's or butler's fittings, a loose box to the stable, sometimes a new laundry, greenhouse, a billiard-room, etc., are often improperly and unjustly called 'extras', being in fact 'additional works', things never originally intended to be done, and should be so termed in the accounts.

The subject of extra work may be treated of, 1, as regards the employer; and 2, as regards the contracting builder. The first must remember that, even should there be extras, he gets money's worth for his money. And if, as is usually the case, the architect takes care to insert a clause in the contract that all extra works shall be done at and after contract prices; or, better still, shall have a schedule of contract prices attached to the contract, the employer pays no more than if they had originally appeared in the specification, and their value had been included in the original tender. There is, however, one strong reason why an architect should be most careful to avoid these charges. It often happens an employer has provided the money to pay the amount of the original contract, but, if unexpectedly called on to pay £500 or £1000 more, he has to raise the sum perhaps at a great inconvenience, and sometimes with great vexation. In most cases, however, it is the employer's own fault: while the plans are in progress the cry is economy; but as the work progresses he is apt to lend an ear to his friends, to the builder, or to the foreman, who are continually suggesting some additional alteration. Then come various charges for cutting down and altering what is up, waste on stuff prepared at the bench and not used, and a host of other things that, though they may be just, are anything but satisfactory. The employer should carefully abstain from giving any orders, to the builder, except through the architect; and the latter, as each additional work is determined on, should contract with the builder at a fair price for the same before commencing, so

that the employer may always know what liabilities he is incurring.

As regards the builder, it is usual to insert a clause, in the contract, that no extra shall be paid for except he has an order in writing countersigned by the architect, directing such things to be done as extras. But it is frequently very difficult to give these orders, as they generally involve a number of things that really cannot properly be described till they are done; and in one case of a large Union, it was held that not giving proper orders was the laches of the architect, and that in equity the builder was entitled to be paid for anything really ordered, whether the same was in writing or not. It was the fault of the giver and not the receiver, and no man should take advantage of his own wrong. Though it is almost impossible in very large works to give orders in writing for every extra, this should nevertheless be done as far as is practicable, and a clause inserted in the contract that the builder at certain times therein specified shall send in an account of anything he may claim as an extra up to that time, so that the same may be examined while visible, and the circumstances discussed while it is in memory, and the claim allowed or disallowed, as may be just: if he should fail to do this, he should be considered to have waived any claim to such extra. The clerk of the works should also regularly report to the architect any saving, that may be effected on the specification, so that any unavoidable extras may be met by some reasonable omissions. Of course a builder has no right to claim for work done of his own will. For instance, if he fix molded doors instead of square to inferior rooms, he clearly cannot charge for them unless absolutely ordered. No work should be charged, that is clearly implied in the specification, although not described at full length. Thus deal described to be fixed is of course supposed to be properly planed, shot, wedged, glued, etc.; jambs are supposed to have proper blocks; hinges and locks proper screws; otherwise a specification must describe every mortise and tenon, every nail and wedge, and in fact almost every stroke of the hammer. Perhaps the fairest way is to consider whether the works are such as the surveyor employed in taking out the quantities would have been taken as a matter of course upon the description. Thus he would take the elbow caps, and labour to bead to boxing shutters (though these are never specified), because they are usual and necessary to make a workmanlike job: but he would not take herring bone strutting to floors unless specially described, however desirable, as many floors are executed without it. CONTRACT; SPECIFICATION; PROVISION; QUANTITIES; SURVEYOR, etc.

A. A.

EXTRADOS. This term is generally used to denote the outer boundary of the voussoirs or stones or bricks which immediately form an arch or a vault: an extradosed arch is explained as one that has the upper line parallel to the under side: an horizontal extrados occurs in most flat arches; but the strict use of the word has not been regarded by many writers, who speak of an arch with an horizontal extrados when they mean an arch carrying a wall finished to a level line. 1. 2. 19. 23.

EXTRUCTOR, properly EXSTRUCTOR. This word, as well as *edificator*, is frequently employed by mediæval writers, and has like it a very indefinite meaning, because they are both applied to the person who paid for an edifice as well as to the architect: in general it may be held that both words, like the terms *construxit*, *erexit*, *evexit*, and *fecit*, apply to the former.

EYCKEN (JEAN VAN DER) succeeded Jean Van den Berghe called Van Reysbroeck, who succeeded Henri de Mol, called Coeman (who died 1469-70), as architect to the cathedral church of Ste. Gudule at Brussels.

EYE. For want of a better, this term was adopted "to indicate the small triangular space, whether pierced or cut, which intervenes between a cusp and the curve that circumscribes it", in tracery in Gothic architecture, by BRANDON, *Analysis*, 4to., London, 1847, p. 26.

EYE. An aperture at the summit of a dome: a small skylight in a roof: and the rim of a vault. **BULL'S EYE; PORT-HOLE.**

EYE BOLT. A bolt with a ring at one end.

EYE BROW. A name sometimes given to a **FILLET**. 1. 2.

EYE FORM. The name given to the vesica-piscis by **RECORDE**, *Pathway to Knowledge*, 4to., London, 1551.

EYELET, OILET, OYELET, or OYLET (Fr. *meurtrière*). A narrow opening, generally wider towards the interior, made in a wall for the purpose of discharging weapons, as is generally presumed from **GULIELMUS BRETONENSIS**, who says 'fenestris strictis et longis ut—immitat—tela', but which in a great number of cases was evidently only the means for obtaining light and air with perfect safety in time of war. The various forms which these openings have had may be divided into the following classes; 1, rectangular holes nearly square, but sometimes twice their width in height; 2, vertical slits from 3 to 6 ft. high, and even more, which are technically called in France *archères*; 3, slits of less height but with a cross slit, which are technically called in France *arbalétrières*; and 4, vertical slits with a circular hole in the centre or at the bottom, which have been assigned to the period when guns came into use. **DALY**, *Revue Générale*, 1843, iv, 401, who gives two sections illustrating the use of the niched head which is frequently found to eyelets.

EYE OF A DRAIN. The opening in the side of a large drain or sewer for the insertion of a smaller one.

EYE OF A PEDIMENT. A circular or oval panel or window in the centre of a tympanum. This is found occasionally in Greek buildings, and more frequently in the Roman buildings of the time of the empire, and sometimes contained the bust of the emperor; instances occur in the pediment of the Propylea at Eleusis, and of the temple to Augustus at Pola. In later times it is of frequent use. **SOCIETY OF DILETTANTI**, *Unedited Antiquities of Attica*, fol., London, 1817. T. L. D.

EYE OF A VOLUTE. A circle in the centre of the volute, from the circumference of which the spiral line commences. **INWOOD**, *Erechtheion*, fol., London, 1827, pp. 127 and 135, pl. 20 and 25, gives fragments of Ionic capitals having the place of the eye occupied by a small additional projecting and eight-leaved rose, "from whence it might be supposed the centres of the volutes of the east and west fronts of the Erechtheion, which are flat on the surface and plain, were painted or gilt; and those of the northern portico are recessed for some ornament that might have formed a projecting rose, as the fragment described." 1. 2. 23.

The eyes of the volutes of the Ionic columns in the temple at Bassæ near Phigalia, were loose apparently for the purpose of occasional displacement to admit of festoons being suspended, or other like decorations. **STUART and REVERT**, *Athens*, suppl. volume, fol., London, 1830. T. L. D.

EYSEN (**PETER**) was government architect 1588, at Vienna and at Prague. 26.

EZELON or **HEZELON**, canon of Liège, directed the completion of the church of the Benedictine abbey at Cluni in the Mâconnais, consecrated 1131, repaired at the Restoration, and now a parish church; **RÉVUE DE BRUXELLES**, 12mo., Brussels, 1837, p. 5.

EZGUERRA (**RODRIGO**) commenced 1546 the parish church at Arenzana de Arriba, near Najera in Spain, which was finished by **Martin Ibañez de Mucio**. His son (or brother) **Pedro de Ezquerria**, called **Ezquera** by **NAGLER**, who attributes to him the cathedral at Plasencia commenced 1498. He was born at Ojebar; built the church of S. Mateo at Caceres, and that at Robledillo, in the diocese of Plasencia, he being architect to the cathedral in that city: he commenced 1551 the parish church at Malpartida, in the same diocese, which after his death 1561 was continued until 1574 by his son **Juan**, a Dominican monk, and was finished by **Juan Alvarez**. 66.

EZIJÁ in Spain, see **ECIJA**.

THE DICTIONARY OF ARCHITECTURE.

FACA

FABER. A word supposed to be connected with the Latin *facere*, and signifying the maker of anything. It was frequently used by ancient and by mediæval writers: and is considered by some translators equivalent to 'master of the works' or 'architect'; in fact the Udine edition of *VITRUVIUS* renders it '*maestro*', but this evidently was not the original meaning, for *CICERO, Epist. ad Div.*, ix, 2, says "to act not only as architects (architectos), but even as workmen (fabros) in building up a republic".

A. A.

A votive inscription found 1723 at Chichester states that the 'collegium fabrorum' dedicated a temple to Neptune and Minerva. It may have been incised about A.D. 50, and is generally mentioned as the earliest notice of associated artificers in this country. A figure of the inscription is given in *HORSLEY, Brit. Rom.*, fol., London, 1732, p. 332. From *PLINY, Ep.*, x, 42, it appears that the imperial licence was necessary to the legal existence of a collegium fabrorum.

FABRA or **FABRE (JAYME)** is considered to have designed the church of the Dominicans at Palma in Mallorca, and the *seu* or cathedral at Barcelona; the former was commenced 17 December 1296, and the latter May 1298. A royal and episcopal mandate for his immediate removal from Palma to Barcelona, where he assisted 9 July 1339 in the translation of the relics of Sta. Eulalia, is noticed 17 February 1318 in his agreement, in which he calls himself 'magister' and 'lapicida', to return when wanted to Palma or forfeit a heavy penalty.

66.

FABRI (FRANCISCO XAVIER), an Italian, who died 1807. He was the real builder of the palace of Ajuda at Lisbon, although his plans were modified by E. Gaetan de Sousa, and although the direction of the works was shared with him by J. da Costa e Silva, and after Costa's death by A. F. Rosa, who succeeded Fabri. *RACZYNSKI, Lettres*, 8vo., Paris, 1846, p. 332.

FABRIANO. A town in the Papal States, which acquired 1474 the title of city, that was confirmed on its becoming the seat of a bishopric 1728. Besides the cathedral, dedicated to S. Venanzio, which appears to have been erected before 1197, and to have had some additions 1435; three parish churches; seven monasteries; four convents; the episcopal residence; a seminario; a foundling hospital; an hospital; and an orphan asylum, are the principal buildings.

96.

FABRIC or **FABRICK** (Lat. *fabrica*, from *faber*). A word applied to the structural parts of a building, in contradistinction to the movable ornaments and fittings. Thus it is said a church rate may be levied for the maintenance of the *fabric*, when it is not allowed for the organ and other accompaniments to divine worship.

A. A.

FAÇADE. The external face or front elevation of any building, but the term is more commonly used to signify the

ARCHITECTURAL PUBLICATION SOCIETY.

FACE

principal front; many examples of which will be found in the *Illustrations*.

1. 14. 23.

FACCI or **ROMENGARDI (LANFRANCO)** is noticed as the architect of the cathedral at Modena, commenced 9 July 1099, according to the statements in *VEDRIANI, Raccolta de' Pittori*, 4to., Modena, 1662, p. 14, who relies upon an inscription on the exterior of the eastern portion of the choir, and towards the palazzo comune de' signori.

FACCRA or **FACRA.** A village on Mount Lebanon in Syria, about half way between Tripoli and Beirout: it contains the ruins of five temples, four of them being of the Doric, the other of the Corinthian, order; and one of the towers (probably mausolea and refuges) which are frequently seen in the Holy Land; *FRANKLAND, Travels*, 8vo., London, 1829, ii, 30, 122.

FACE, see **HEAD**.

FACE, commonly called **PLAIN FACE**. The labour usually given to finishing the front of a stone whether used as plain ashlar, slab, hearth, mantel, jamb, paving, step, etc. This term is used in contradistinction to labour on the faces out of sight, as 'bed', and 'joint', and also to labour on any molded, tooled, or rusticated work.

A. A.

FACED WORK. As, up to the commencement of the present century, masons understood by **ASHLAR** a large squared stone, they have since appropriated this term to the thin stone otherwise called bastard ashlar employed to imitate the larger work, and which is now generally simply termed ashlar in specifications.

FACED WORK, in painting. A name now nearly obsolete for work where every coat is rubbed down with pumice to a fair face, and all the marks of the brush obliterated before the next coat is laid on.

A. A.

FACED WORK, in plastering. A term denoting work of which the surface is finished in a manner superior to ordinary work; as trowelled stucco, hand floated work, etc.

A. A.

FACE MOLD. The name given to the mold, cut out of a thin piece of wood, the lines of which are found by connecting the intersections of co-ordinates derived from the plan and section of a hand-rail. It represents the upper surface of the rail as it is intended to be in position, and is in fact a sort of oblique plan. When used it is applied to the plank, and lines are scribed to direct the saw cut. **FALLING MOLD**; **HAND-RAIL**.

A. A.

FACE WORK, or **PLAIN FACE** in masonry. The result of labour on that surface of a stone which is intended to be seen, in contradistinction to a surface that is self-faced, or where the natural cleavage of the stone forms the face.

Soft freestones as Bath and Caen, are sawn with a dry saw, the rough parts or winding faces removed with the chisel or tool, and the surfaces finished with a rough or fine drag, or rubbed with dry York or other gritstone, sometimes with sharp

sand between. Soft sandstones, hard limestones as Portland, and hard gritstones as York, are sawn wet, the tool and chisel being then used if necessary, and the surfaces further rubbed with sand and water by friction with another stone.

When the value of the stone to be saved by sawing is slight, or when the saw cannot be readily used, the face of a block is taken out of 'winding' or brought to a plane superficies by the tool, thus: a line is scribed on any convenient side and then projected on to the other sides of the block by squares or bevels, or by 'boning' with banquer rules, as the case may be. The extremities of the plane being thus formed, a tooled draught is worked round the outside and then crossed from corner to corner. The superfluous stone or 'waste' is then knocked off with the point and the face tooled down sufficiently fine to receive the finish of the drag, or the sand and water, as the hardness of the stone may require.

After being scapled, broached, and draughted, a hard stone sometimes receives irregular marks from the broad chisel called a boaster; and if so left, the work is called *random tooled* in England, and *droved* in Scotland: if the stone receives regular marks like ribbands or strips of small chequers, the work is called *axed*, *hewed*, or *boasted*. Further processes upon droved or random tooled work consist in marking with a chisel, an inch or three-quarters of an inch wide, regular and parallel stripes running at right angles to the bed, which give a *tooled* face, sometimes described as broached in lines not coarser than sixteen, eighteen, or twenty to the foot, technically termed 'a broad or narrow bat'; and in working either over this or instead of it, according to the nature of the stone, stripes made with a chisel of half the above width, i.e. from $\frac{3}{8}$ to $\frac{1}{2}$ in. wide, which produce a *chiselled* face, sometimes called striped, or droved and striped, work; and when further stripes are produced with a still narrower chisel, about $\frac{1}{8}$ in. wide, the stone is said to have a *pointed* or *fine tooled* face.

Masons differ among themselves as to practice, result, and terms, so much that while workmen in some localities follow an old routine of executing faced work, others shorten it very materially, so that some descriptions of work are now rarely, if ever, seen; workmen from the north can sometimes hardly comprehend the expressions used by those from the south; and it is also stated that almost every quarry has its own peculiar set of terms. Thus a hammer-dressed face is said to be scapled, skabled, or skiffled, in some counties it is called knobbed; a broached face is termed clean-picked, close-picked, picked fair, and also inch-tooled; a broached, axed, or hewed, face is also called fair-tooled, and sometimes simply dressed; a broached, droved and broached, or tooled face, is shortened into droved and broached; so a broached, droved, and striped face, is abbreviated to droved and striped. A hammer-dressed and broached face to granite is said to be nided or nigged, this is sometimes described as smooth, and as fine hammer-dressed. When the stone has a draught round it, that should be named, then occur the terms scapled and draughted, broached and draughted; or if the draught be worked, then according to the work there may be a broached tooled aris listed face, also called tool-draughted on the aris and close-picked on face; or chisel-draughted to picked dressed face, also called broached work with droved (for chiselled) margins.

If the face of the stone project before the draught or margin, such face may be worked in a variety of manners, which will be explained under *RUSTIC* work.

The face work obtained during the Mediæval period is sometimes said to have been produced by the axe up to about the time of rebuilding Canterbury cathedral, 1178, when the chisel was introduced; but in the *Cotton MS. Claudius*, B. iv, fol. 19, executed about 1000, the chisel is clearly shewn: the employment of a tool with a serrated edge, varying in degrees of fineness according to the period, is mentioned by VIOLLET LE DUC, *Dict.*, s. v. *Bretteure*, as common after the middle of the twelfth century. *BRETTEURE*.

It is unnecessary to treat of the employment of machinery to give a face to stone, further than to say that after the saw, the machine employs chisels and bits to execute moldings as well as plain faces. *PLANING MACHINERY*.

Slate has either a rough face, as split in the quarry, 'self-faced'; or a sawn, or a rubbed, face.

Granite is reduced at the quarry very nearly to the form required by being coarsely shaped with scabbling hammers or cavils (*scapled*), and is afterwards brought to a face with a jedding axe, pick, pick-axe, or stone axe having a sharp *pen* or point (*broached*); (in Aberdeen the whole operation, called nidding, is performed by the hammer, and produces nided work;) and it is then ready to be finally treated for moldings in the same manner (except that pointed instead of broad tools are used) as marble or stone. In London the two usual kinds of faces are known as 'plain face roughly axed' and 'plain face finely axed': if a finer face is required, granite must be polished.

Marble being always sanded and polished, the term plain face is not usually applied to it.

FACET (Fr. *facette*, dim. of *face*). A word used by jewelers to express each of the different polygonal faces or planes into which gems are cut. In architecture the term is applied to masonry in which each stone is worked into regular projecting faces, analogous to bossage or *RUSTIC* work, except that the faces are not rough, but perfectly regular, meeting in a point or at an aris, according to the stones being square or oblong. The most curious specimen is to be seen on that side of the ducal palace at Venice under the Bridge of Sighs, the stones being as wide as high are cut into facets alternately projecting and receding from the general face. A remarkable example of the use of projecting facets over the whole façade of a building, is to be found in the palazzo del Magistrato (?) at Ferrara, now used as the picture gallery; an illustration is given in GAILHABAUD, *L'Arch. Mon.*, etc. This peculiarity is also seen in some palaces at Naples.

One of the towers of the castello Gavone near Finale, is fronted with stone cut in facets like those seen at Crichtoun castle in Scotland, illustrated in BILLINGS, *Baronial Antiq.*, 4to., Edinb., 1848-52, and referred to by SCOTT, *Marmion*, 4, xi, 17-19—

"Above its cornice, row on row
Of fair hewn facets richly show
Their pointed diamond form."

In buildings of the Elizabethan style these facets are constantly employed. LETAROUILLY, *Rome Moderne*, fol., Paris, 1825, pl. 110, gives an example of a similar effect produced in sgraffito. *DIAMOND*; *NAIL-HEAD*.

FACET is also said to be a term given to the flat projection between the flutes of columns. 1.

FACIA, see *FASCIA*.

FACING. Any material, whether brick, stone, etc., of better quality or appearance than the general substance of a wall, applied to ornament or to protect its surface. Thus ashlar work is called 'facing', in contradistinction to the rough stone, or the brickwork, behind it, which is called 'backing'. A. A.

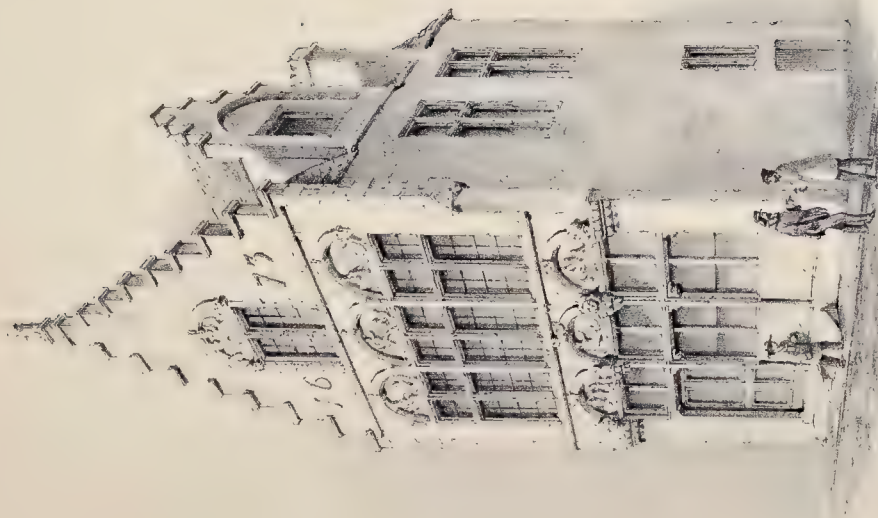
FACING BRICKS. Bricks of a superior character and appearance used for the fronts of buildings, and selected either from clamp burnt bricks, as picked stocks; and as malm bricks, which are subdivided into pickings, pavours', second, or best malms or cutters; or else they are red or white kiln bricks, viz. those burnt in close kilns and not in clamps: a description of all these is given in *BRICK, MANUFACTURE OF*, p. 138. A. A.

FACINGS. The wooden coverings of the sides of windows and door-places in the insides of rooms, intended to give them a smooth and finished appearance. 2.

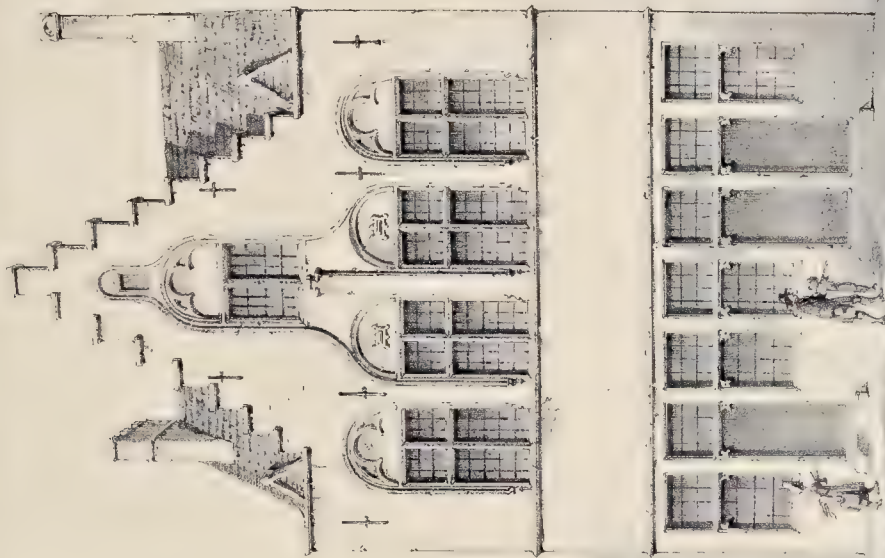
FACTABLING or *COPING*. A mistake in some books for *FRACTABLE*.

FACTORY. In its original signification, a building or collection of buildings in which the European merchants of each nation, and their agents or factors (Fr. *facteur*) of each dwell

FRANCIS
HARRIS.



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2000



FACADE



THE FACADE OF THE CHURCH OF ST. MARTIN, LONDON

Edward Blore, Architect



FAÇADE

(Brick)

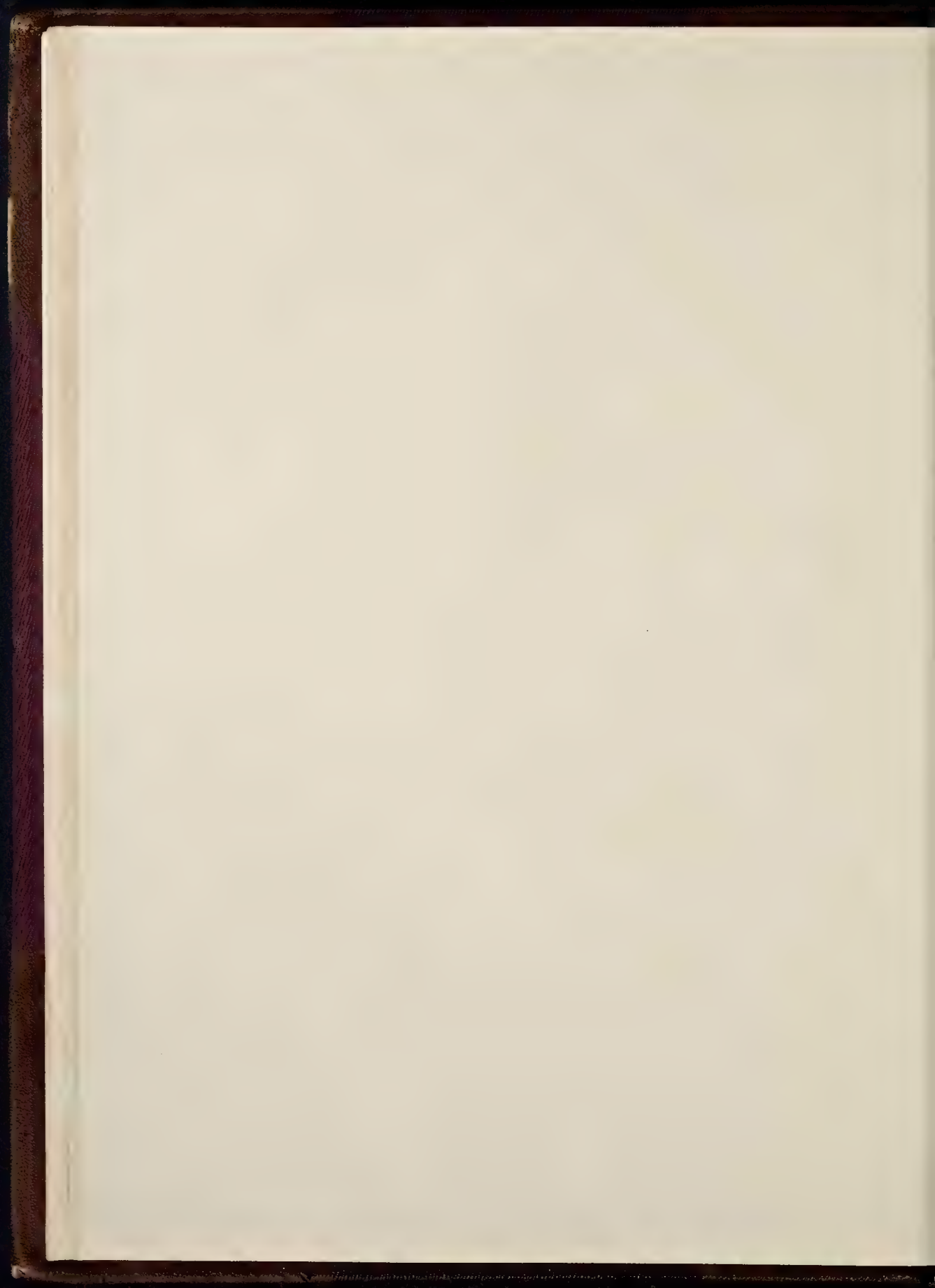
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F. L. Bonaldien M. I. B. A.

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FACADE.

Fig 1

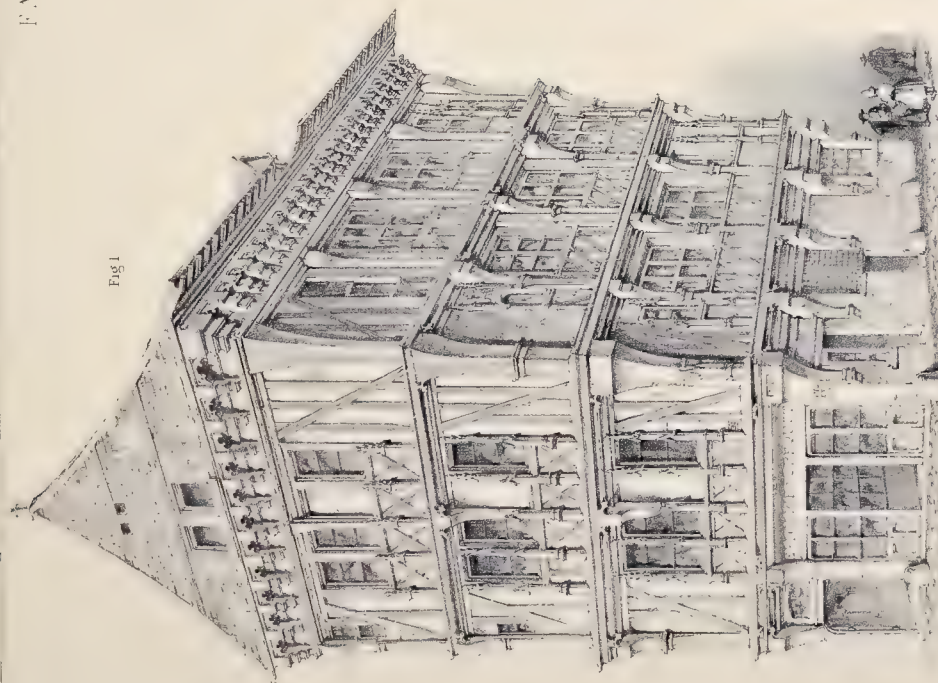


FIG. 1.
PALACE OF THE SULTANA
CONSTANTINOPLE.

Fig 2

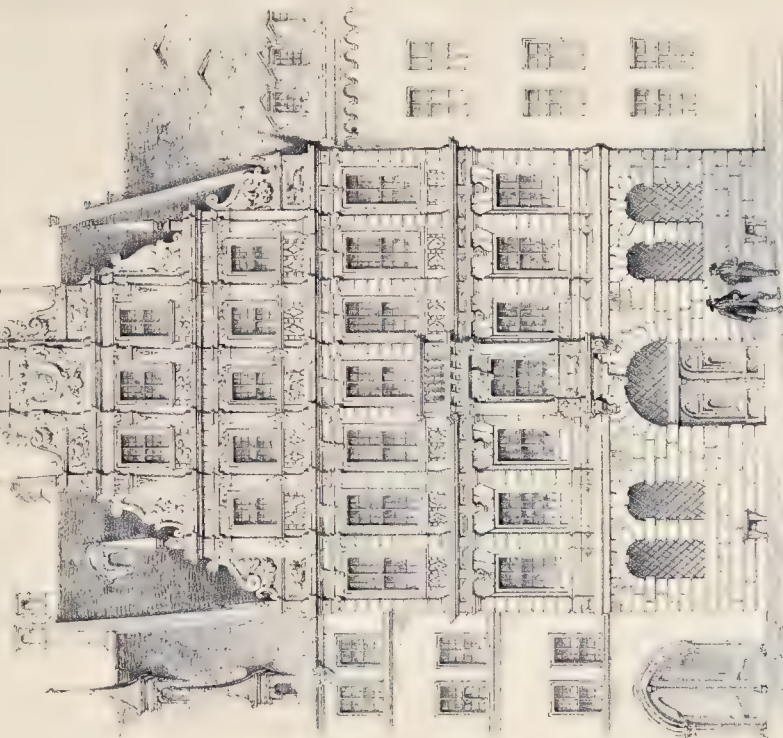
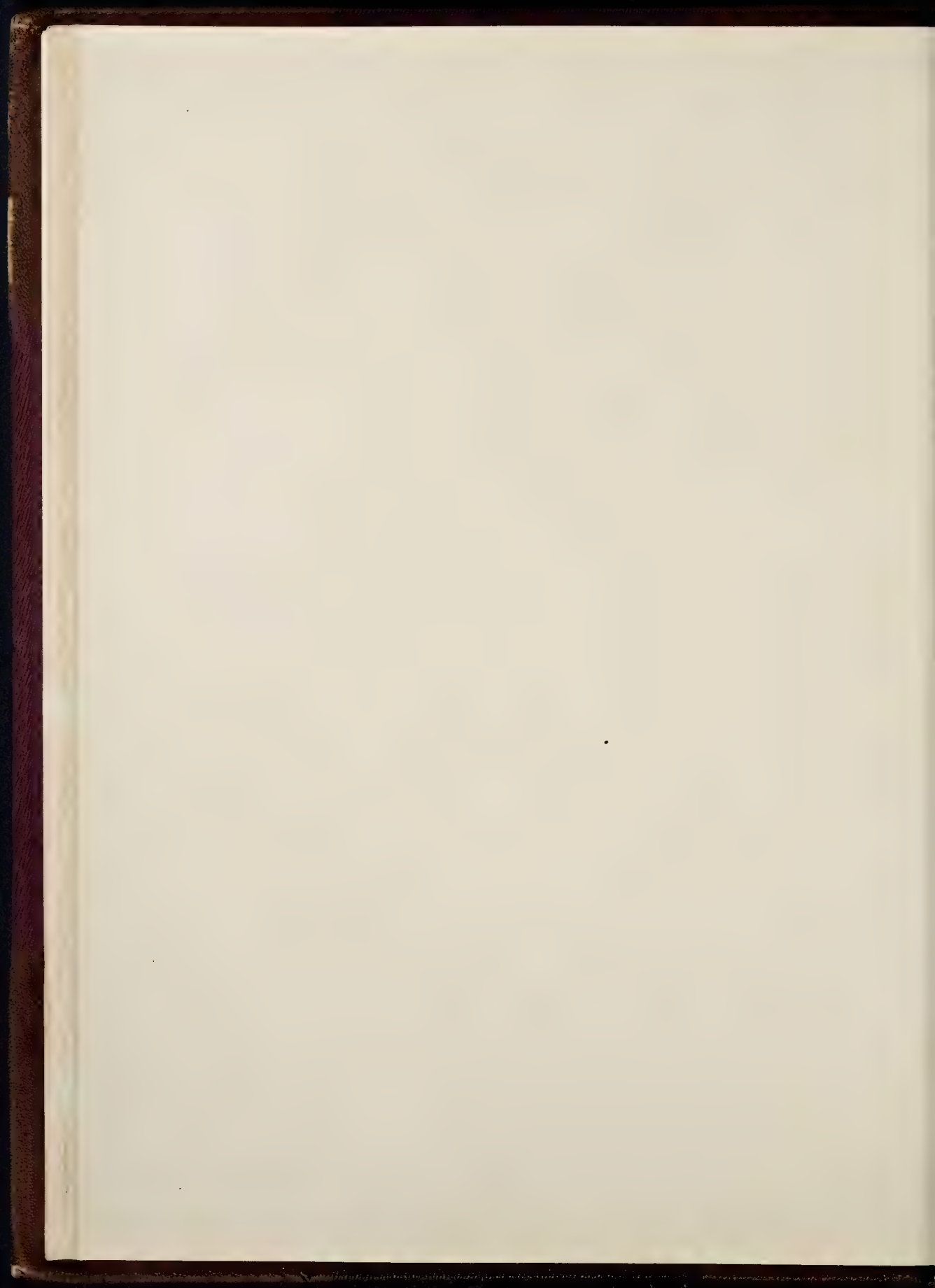


FIG. 2.
NUREDDIN
ALEPPO.



FACADE

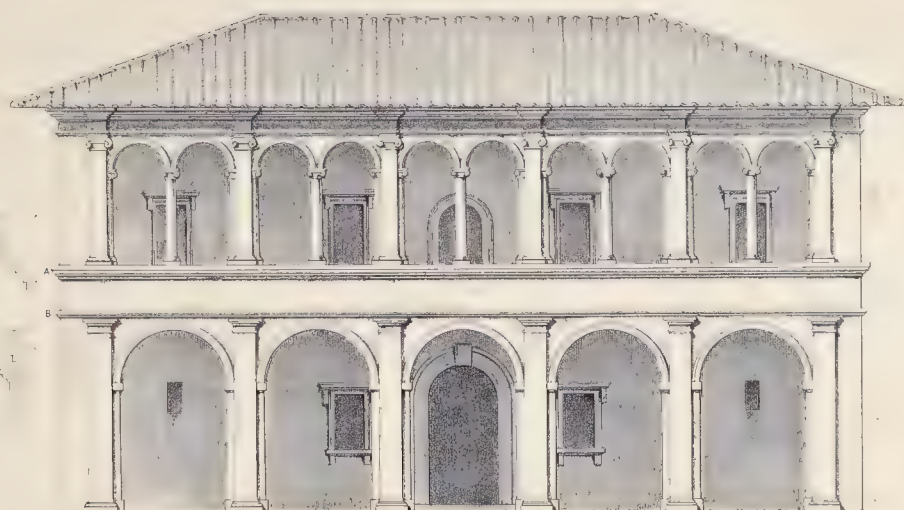


AL 116 FT

James L. Donaldson, M.D.A.

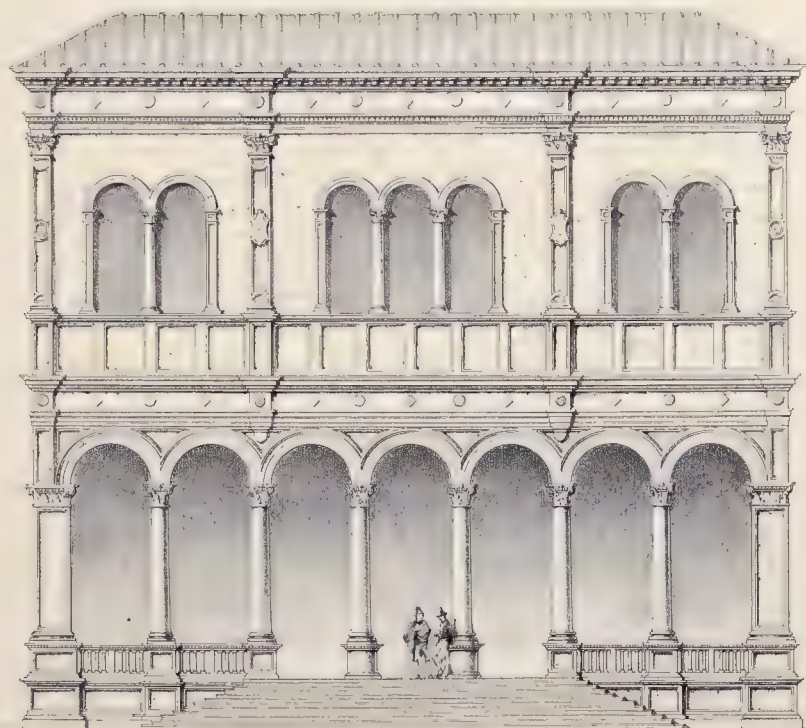


FACADE



RECTORY HOUSE — MONTE PULCIANO

Thomash. Denoldsen J. L. E.



ORDO DI GUARDIA — LUCCA

A. L. E. S.

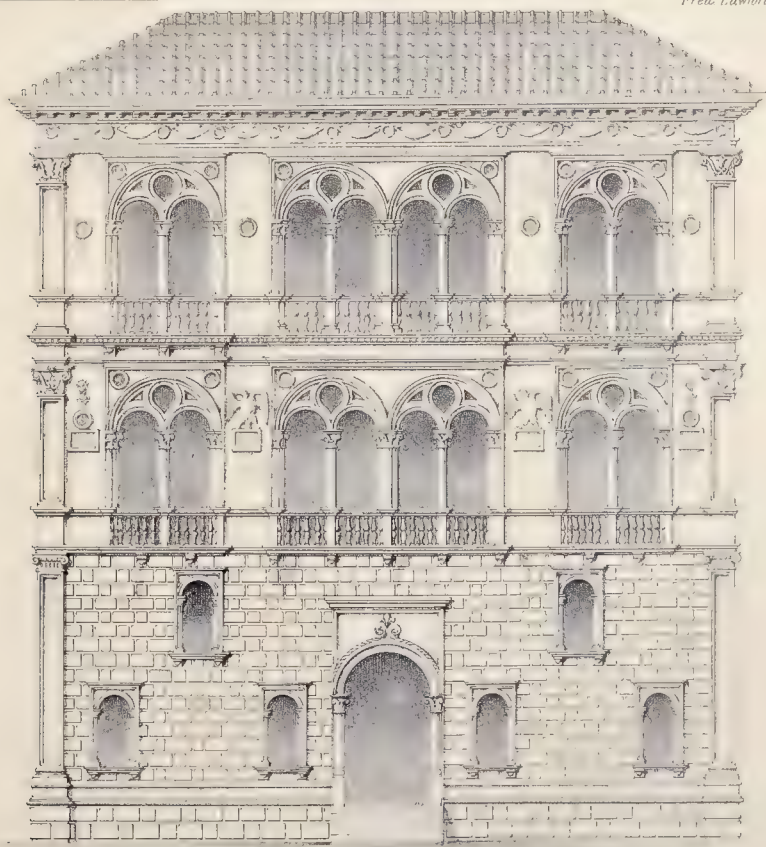


FACADE.



PALAZZO FABBIA — BOLOGNA

Fred. Lawford M.B.A.

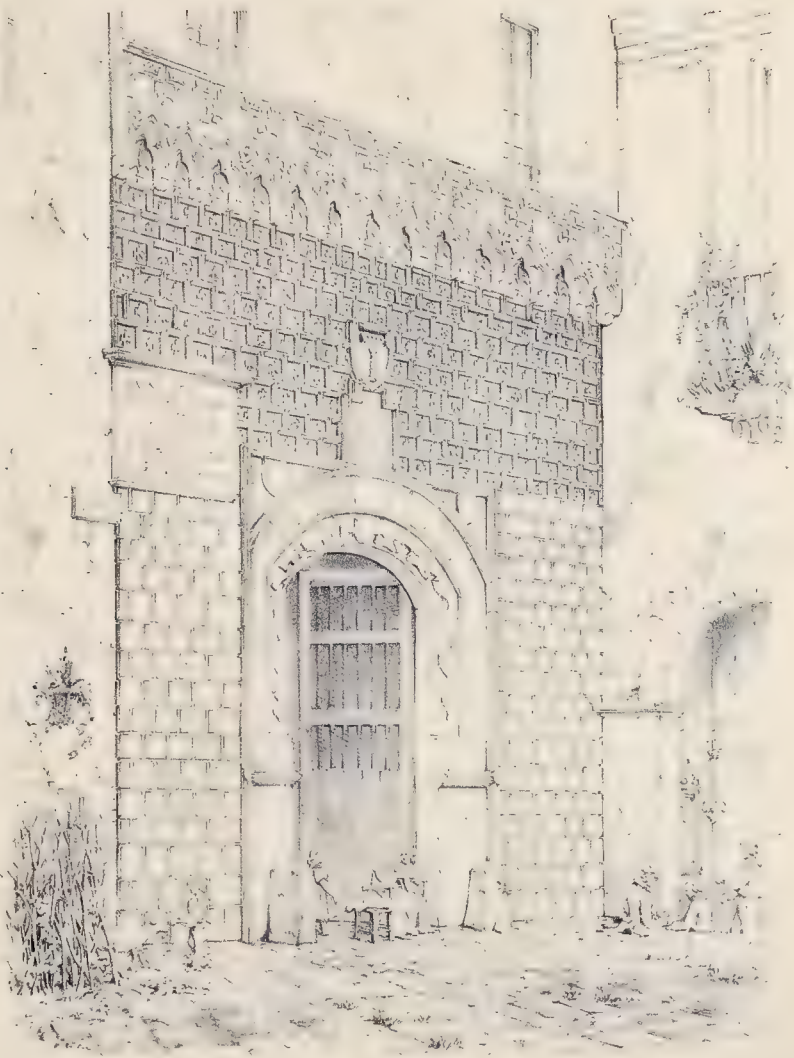


PALAZZO CORNER SPINELLI — VENICE

M. Lockyer M.B.A.



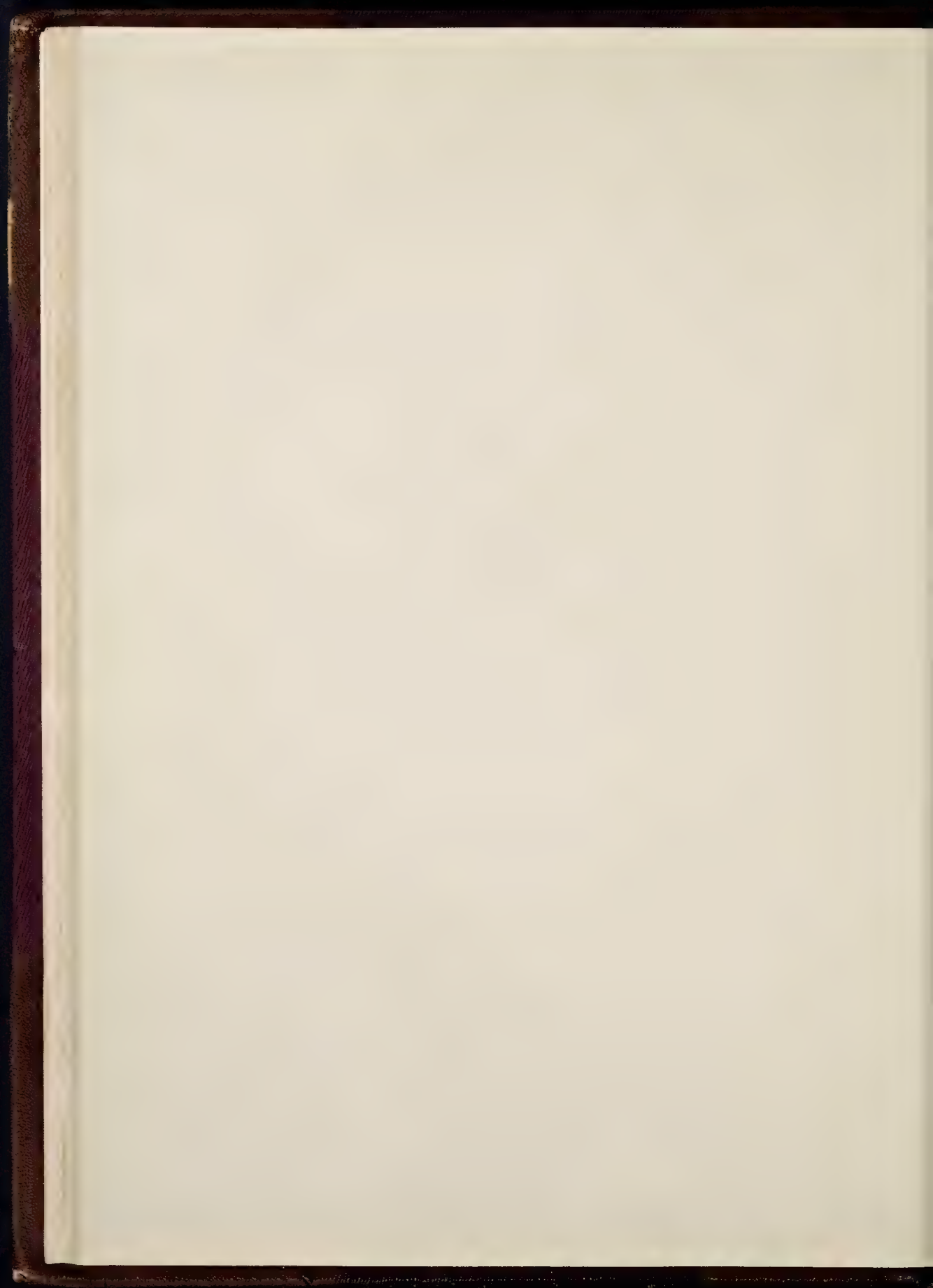
FACADE.



ANCIENT PORTAL, NEAR THE ARCIVESCOVADO



BORDERS FROM THE PORTAL OF THE CATHEDRAL OF ST TROPHEME



together with their compatriots and rivals in the East under domestic jurisdiction, house their goods, and transact business. Such structures resembling to some extent the caravanserai (or rather khan) of the Asiatic nations, were not uncommon in Europe itself during the middle ages; even lately the English had a factory at Lisbon, and some remains of the system still exist in the cases of the Russian, Persian, and Tartar bazaars at ASTRAKAN. During the fourteenth and fifteenth centuries, London, Novgorod, and Bruges were the most important places of commerce in the north of Europe; sixteen mercantile associations which existed in the latter town are enumerated by GAILLARD, *Ephém. Brug.*, p. 71, the Hanseatic merchants having appeared there before 1345; while the most recent settlement, that of the Turks, was not formed until the commencement of the sixteenth century: SCHAYES, *Hist.*, 12mo., Brussels, 1851, iv, 55, states that each association had its *hôtel*; that nearly all these buildings were works of such importance architecturally as suited a destination which gave them almost the character of public buildings; and that the most remarkable of those constructed in a Pointed style appertained to the Hanseatic, the Castilian, the Florentine, and the Genoese merchants. The first named, designed 1478 by J. Van de Poele, which existed until the end of the eighteenth century, was considered the finest of these four; sketches of them are given by SCHAYES, who refers to GAILLARD for views of the *hôtels* of the Spanish, Scotch, Portuguese, and English merchants. The *maison Hanséatique*, constructed 1564, on a site about 230 ft. long and 200 ft. wide, between two basins or rather open docks at Antwerp, is still in perfect preservation. The *fondaco dei Tedeschi* at Venice, now the dogana, built after the destruction of its predecessor by fire 1505, at the foot of the Rialto, is the best preserved of similar establishments in that city, and is of singular beauty of detail. 28.

FACTORY used in any other sense is an abridgement of manufactory.

FACULTY. A privilege or special power granted to a man by the favour or indulgence of a diocesan, to do that which would otherwise be positively against a strict construction of the law, or at least open to objection in consequence of a want of authority derived from the law. Thus an application ought to be made to the Bishop's Court for a faculty (*i. e.* for leave and license) to have a vault in a churchyard; for it has been considered, that proceedings might be taken against a rector who, assuring the applicant for his consent to the construction of such a vault that no other authority was requisite, had assumed the power and office of the ordinary. A vault in a church is still more the subject for a faculty, except perhaps where a buryingplace within a church is prescribed for as belonging to a manor-house. The appropriation of a pew or an aisle is another subject for a faculty, though it is said a church may be entirely repewed without one. In short few things can be done in alterations or even in rebuilding of an ecclesiastical edifice and its appurtenances without a faculty: and any one may be obliged to apply for it by an opponent who exhibits articles in the Bishop's Court charging him with having done such things without a faculty. In some cases a clergyman or a benefactor may risk the improbability of interference and seek, after the work is done, for a faculty. The usual process, in cases where building is concerned, is to make application setting forth the circumstances of the case and the object; this, if favourably received, is followed by a citation from the bishop to the churchwardens or others whom it may concern, a copy of which is affixed on the church doors, and, if no opposition be offered, the record of the said citation empowers the bishop to issue a faculty, but if objected to, then the bishop or his officers, after due inquiry, makes his decree, granting or refusing the faculty. J. T.

FADEN. A Russian measure of length; one faden or sagene being equal to three arschines, or seven English feet: BAUZEITUNG *Journal*, ser. 2, pl. 383. ARSCHINE.

ARCH. PUB. SOC.

FAENZA, the Roman Faventia. A walled city in the Papal States in Italy, which retains the quadrangular plan and the piazza receiving the two principal streets. In the seventeenth century it possessed seventy-two churches. EUSTACE, *Classical Tour*, says 'its cathedral is Gothic and not remarkable'; but this cathedral, dedicated to S. Pietro, is described by WEBB, *Sketches*, 8vo., London, 1848, p. 443, as a large classical cruciform church, built of brick, vaulted in bays with large round clearstory windows, and round windows in the aisles above the lateral chapels; behind the altar are the stalls. It has a dome; was commenced 1473-4, and was consecrated 15 October 1581; the design is attributed to Bramante Lazzari. The same author mentions a large brick classical church, with a square panelled tower also of brick; and the very large classical church of S. Francesco, with an unfinished west front in rough brick. There are fourteen other churches; four monasteries; two or three convents; and a Jesuit college, to which, on its reestablishment 1843, the fine church of Sta. Maria dell' Angelo was annexed. The piazza Maggiore, with its two storied loggia on each side, and handsome tower (another and opposite tower was pulled down 1776); the large palazzo della Comune, formerly the palazzo Manfredi; the teatro nuovo, erected 1788 by Pistocchi; a very large hospital, founded by bishop Cantoni 1742-67; two orphan schools; a public library; a gymnasium; and the episcopal residence, with a seminary attached, are the other principal objects of interest. The ancient bridge of three marble arches was washed away 14 September 1842. RIGHT, *Annali della Città*, 1840. The manufacture of *maiolica* in this city dates apparently from the fourteenth century; VASARI, *Lives*, 12mo., Lond., 1852, v, 44. 96.

FAENZA (ANDREA DA), see MANFREDI (ANDREA).

FAESCH (JOHN RUDOLPH), lieutenant-colonel of engineers and architect at Dresden, is not to be confounded with J. G. Rudolph Faesch who died after him, *i. e.* 1787, and published *Verzierung der Fenster*, 4to., Nuremberg, 1781; and *Versuch von Gebäuden*, fol., Nuremberg, 1780, with several editions of his translation of Vignola. 68.

FÆSULÆ. The ancient name of FIESOLE.

FAGARA PTEROTA, Sapodilla wood. A wood brought from Honduras, and used for machinery purposes and turning. F. rhetza, *Bajarmondi*, a native tree of the forests of Gualpara in the East Indies, gives a close, hard, tough wood. 71.

FAGREA FRAGRANS, *Annah-beng*. A native tree of the forests of Martaban in Asia, supplying timber of a large size. The wood is compact, and very hard, weighing 52 lb. 8 oz. per cubic foot, of a yellow colour, and very beautiful. 71.

FAGUS, the Beech. This tree is a native in all temperate climates. In dry sandy or chalky situations, it becomes one of the handsomest of English trees, and in the forests of the north of America it is one of the tallest and most majestic.

F. sylvestris or Americana, white or common Beech, though found so large as 8, 9, and 11 ft. in circumference, and more than 100 ft. in height, has seldom more than 3 ins. of perfect wood in a diameter of 18 ins. (*Fr. hêtre*.)

Fagus ferruginea, Red Beech, from the colour of its wood (a whitish brown of different shades) not of its leaves, is, in America, almost exclusively confined to the north-eastern parts of the United States, and to the provinces of Canada, New Brunswick, and Nova Scotia: extensive forests are found in the districts of Maine, and in the states of New Hampshire and Vermont. It equals the white beech in diameter but not in height; and the wood is inverse to that of the white, as 3 or 4 ins. of sap is found with 13 or 14 ins. of heart.

Being extremely liable to injury from worms, and speedily decaying when exposed to dryness and moisture alternately, it is rarely used for house building; TRENGOLD records that the Beech rots soon in damp places, but it is useful for piles in situations where it will be constantly wet; and it is so used on the continent. But the Custom House, London, built 1813-7 by D. Laing, was founded on piles and sleepers of beech, under the recommendation of J. Rennie, which were entirely decayed in about ten years and caused the failure of the building, afterwards reinstated by Sir R. Smirke, R.A., at an expense of nearly £200,000. It is said, however, to be

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very durable when preserved from humidity, and incorruptible when constantly under water, it has been therefore used in America for the lower parts only, of ships. Experience proves it should be felled in the summer, while the sap is in full circulation; felled in the winter, it decays from the worm in a few years. Thus a tree cut in 1830, and used as a beam in a cottage, was in 1856 found perfectly sound, though it had not been painted or whitewashed; *GARDENERS' CHRONICLE*, 1856, p. 70.

Beech wood is principally employed for bedsteads and chairs, when it is often stained to represent mahogany; or as ebony for smaller articles. It was formerly in demand for sleepers for railways when kyanized. In Hampshire it is used for barn floors, and when kept free from damp by a thorough ventilation underneath, they are said to last many years. In Scotland and in Ireland, where the wood is often used as rafters to cottages, it is rendered more durable by impregnating it with pyroligneous acid derived from the smoke of beech-spray and the chips, when it becomes of a brown colour. In France it is extensively used for *sabots*, when it is often treated in the same manner.

Several varieties are propagated, as the purple beech, lately introduced in gardens, and the fern-leaved beech, both being beautiful trees; with the crested beech, very much to the contrary.

MICHAUX, *North American Sylva*, 8vo., Phil., 1819, iii, 18, 21; LONDON, *Arboretum*, etc., p. 1949; PENNY MAGAZINE, xii, 158, 173. 14. 71.

FAIN or DE FAYN (PIERRE), 'maître maçon demeurant à Rouen', seems to have 1507 been architect and master mason at the château de Gaillon. The arch or gateway now exhibited in the court of the école des Beaux Arts at Paris, was constructed 1509 by Fain, at a cost, including materials, of 650 livres, equal to about £468 of present English money. DEVILLE, *Comptes de Dépenses*, 4to., Paris, 1850, 186, 319, 255, 425, 431, preface lxxviii, has explained the difference between its former and its present condition; and xcvi, has noticed the sum of 18,000 livres paid to Fain and his assistants or partners for the works 1507-9, chiefly to the chapel and the great staircase, 'grant viz' leading to it: he was also engaged on the kitchens, etc., at Gaillon, and on the archiepiscopal palace at Rouen for the same cardinal 1501-2, according to DEVILLE, xcix, on which statement the palace is attributed to Fain by DUSSIEUX, *Les Artistes*, 8vo., Paris, 1856, liii.

FAIRBAIRN'S BEAM AND GIRDER, see GIRDER.

FAIRHEAD STONE. The quarries supplying this stone are situated in the parish of Grosmont, in the vale of the Esk, North Riding of Yorkshire. The stone is of the millstone grit formation, of a light greyish-brown colour; it consists of quartz grains moderately coarse, with argillaceous cement, a few small plates of mica, and occasionally small ferruginous spots: *BUILDER JOURNAL*, 1851, ix, 639.

FALAISE STONE, see CALVADOS.

FALCETTA or FALCETTI (GIOVANNI BATTISTA) designed one of the chapels in the church of S. Martino dell' Avesa, now S. Martino Maggiore, at Bologna. This work was restored 1753 by A. Torregiani. He was also employed about 1620 for some portions of the palazzo Bentivoglio in that city, where he died 1629. 105.

FALCONE (GIOVANNI ANGILOLO), see CANTONE (P. F.)

FALCONE (NICOLÒ) designed the new façade of the church of the Augustinian convent of Sta. Maria Maddalena at Naples. 95.

FALCONETTO (GIOVANNI MARIA), born 1458 according to VASARI, studied at Rome and at Naples during twelve years, supporting himself by working half of each week under some of the leading artists, being himself far from insignificant as a painter and sculptor. He left Verona, the home of his family, for Trento, and finally settled at Padua, where he erected at the palazzo Cornaro, afterwards Giustiniani, near the church of S. Antonio, the loggia of two stories of five arches, with Ionic over Doric columns, the architrave inscribed "Joan. Maria Falconetus architectus Veronensis. MDXXIII", which is considered as his masterpiece. VASARI explicitly states that the palazzo itself was built by Falconetto from the design of his client, and does not mention, that for the same client he erected 1523-4, at-

tached to this mansion, a place for musical entertainments which is said to have suggested the plan of the Rotonda del Capra; a plan given by SEROUX D'AGINCOURT, *History*, fol., London, 1847, pl. 72, fig. 28, is reversed from one accompanied by an elevation and section, which are incorrect, in SERLIO, 4to., Vicenza, 1618, vii, 218. He next erected the city gate called S. Giovanni, 1528; another called Savonarola, 1530; and the portal with double columns of a Doric order to the palazzo del Capitano, 1532: all these works have inscriptions similar to that first cited. The introduction of the revival of Roman art in Verona and Venice is attributed by VASARI to Falconetto; he also notices several designs made by Falconetto, including one for the church of Sta. Maria delle Grazie of the Dominicans at Padua, which was not completed, the funds having failed 1572 at the death of pope Pius V; and one for the palazzo Savorgnano at Usopo in Friuli, which was rising above ground when the works were stopped by the death of the owner. VASARI states that Falconetto died 1534 aged seventy-six; while MONTROSSO, *Annali* (MS.), says 1537 aged seventy-four; TEMANZA, *Vite*, 4to., Venice, 1778, affirms that he lived until 1553, from a mistake corrected by BRANDOLESE, *Pittura*, 8vo., Padua, 1795, pp. 37, 160, 176, 200, 253, 276, who considers that he was then only fifty-four years of age, and gives the preamble of the contract made 28 January 1533 (not 1553) to make, cover, and decorate the chapel of S. Antonio in the church dedicated to that saint at Padua. LALANDE, *Voyage*, 12mo., Paris, 1769, viii, 280-1, states that the 'cortile pensile' of the palazzo del Podestà, decorated with a Doric (!) order on the second story, is said to be by Palladio, but is attributed by TEMANZA to Falconetto in 1558; this may be the design with an Ionic over a Doric order fully given in the Udine edition of *Vitruvius*, vi, 3, which also gives the porta Savonarola, i, 2: and that the neighbouring palazzo del Capitano in the piazza de' Signori, was commenced 1599 (!) by Falconetto, whose father was Galeazzo Mendella according to ORLANDI, *Abeceario*, 4to., Bologna, 1743, but Mondella as asserted by BOTTARI, in his *Vasari*, 4to., Rome, 1759, ii, 377. 3. 73.

FALCONIERI (PAOLO) made a design for the completion of the Pitti palace at Florence, which is described by BALDINUCCI, *Vite*, s. v. Ammanato; but was not put into execution on account of its estimated great cost.

FALERIA, FALERIONE, or FALERONE, the Roman Falaria, Faleria Picena, Falerio, and Falerione. A town of the Papal States in Italy. It is more celebrated for the amphitheatre of the time of Hadrian, 1200 palms in circumference with twelve entrances; and for the theatre, nearly entire, dedicated A.D. 43, described by DE MINICIS in two works published at Rome 1833 and 1839; than for the palazzo Eufreducci now Comunale. The town was the seat of a diocese united to that of Fermo in the seventh century. 96.

FALERII. The Etruscan name of the site of CIVITA CASTELLANA.

FALERIUM. The Roman name of the site of FALLERI or FALARI (STA. MARIA DI).

FALKNER or VOLKHNER (OCTAVIAN) of Cracow, is the (pretended?) name of the first *baumeister*, 1141-7, of the tower to the cathedral of S. Stephen at Vienna. 26. 92.

FALL. A measure of length used in Scotland, corresponding to the English pole or perch.

Scottish acres.	Imperial acres.	Scottish rods.	Falls
1 =	1:261183	= 4 =	160
			1 = 324 Scotch ft.
Scottish mile.	Imperial feet.	Scottish furlongs	Falls.
1 =	5929:568	= 8 =	320
		Scottish feet.	
1 =	5760		1 = 18 Scotch ft.
			1 = 18:5299 Eng. ft.

FALL (Sp. *arza*; Fr. *garant de palan*). The rope of a tackle. ROPE.

FALL. The slope, given to any pavement, flat, or gutter,

for the conveyance of water from it: thus gutters are supposed to be usually laid by the carpenter with a fall of $1\frac{1}{2}$ ins. in 10 ft., or 5 ins. in 20 ft. inclusive of a proper drip if there be only one in that length; not only pavements, but landings, should have a fall, whether or not exposed to rain. DRIP.

FALLERI (STA. MARIA DI), or FALARI, the Roman Falerium; see CIVITA CASTELLANA.

FALLING MOLD. The name given to the elongated vertical section, or representation of the 'stretch-out' of a hand-rail, derived from the plan and section of the staircase; it is used in connection with the FACE MOLD to scribe the plank in order to direct the saw cut. HAND-RAIL. A. A.

FALLING STYLE. A synonym for SHUTTING STYLE. 8.

FALSE ARCADE. A range of arches filled in with lights. In the house supposed to have been that of Julius Polybius at Pompeii, the portico of the atrium is formed by arcades and piers, the centre being occupied by a court and fountain; these arcades appear to have been closed by windows, as square holes that seem to have received the frames are worked in the marble coping of a dwarf wall which surrounds the court. An antique painting, representing the baths of Faustina, shows a portico having the apertures entirely glazed. Some of the mediæval cloisters were originally glazed, e.g. the Campo Santo at Pisa, as appears by an inscription and was proved by the discovery of a small piece of glass in the tracery, which had not been observed even by LASSINO, as mentioned by S. SMIRKE, R.A., in the *ARCHÆOLOGIA*, 1831, xxiii, p. 5. The terms *arcade-feinte* used by VIRLOYS, *Dict. s. v.*, and *arcade-simulée* used by DE CAUMONT, *Cours*, 8vo., Paris, 1830, iv, 133, have the same meaning as BLANK ARCADE.

FALSE ARCH. This name is sometimes applied to a curved construction, in plaster, wood, or iron work, which is properly an ARC. It is more correctly given to corbelled horizontal courses of brick or stone the angles of which are cut to the curvature necessary to give the desired appearance of a true arch, or vault, to the finished work.

FALSE ATTIC. A wall, or other erection, higher than a mere parapet, used to conceal a roof, but not to enclose any rooms. In France the term *faux-attique* has been given to an attic without casements, pilasters, or balustrades crowning a building, as at the porte S. Denis and porte S. Martin at Paris; as well as to an entablature of extraordinary height, as that of the porta Pia at Rome. The Italian architects apply a term equivalent to 'false attic' to a pedestal between two orders placed one over the other. The upper outer order of S. Paul's cathedral, London, may almost be classed under this term, being a mere screen to the upper part of the nave.

FALSE BEARING (Fr. *porte à faux*). When a main beam or girder has not a continuous support throughout its whole length, it is said to have a false bearing, or as many false bearings as there may be intervals between its supports derived from piers, or from other walls or partitions built in a direction transverse to that of the work in question. A column over an opening is another example of a false bearing.

FALSE DOOR. A door, which is not made to open, having the usual dressings and fittings. In modern works such doors are usually placed to obtain uniformity in a handsome apartment: in ancient times they seem to have been chiefly applied, for external decoration, on the fronts of tombs; specimens of such usage at Aizani, Ancyra, Antiphellus, Cyane, Pessinuntum, and Telmissus, in some of which even the handles and bolts are imitated, given in *TEXIER, Asie Mineur*, fol., Paris, 1839, pl. 37-8, 51, 169-227, are paralleled by those of the tombs described by DENNIS, *Cities, etc., of Etruria*, 8vo., London, 1848, who, i, 338, mentions the painted doors at Tarquinii, which may be compared with that in the basilica of Eumachia at Pompeii. The tomb of Theron at Agrigentum is a very complete instance of such a feature; given in DONALDSON, *Doorways from Ancient Buildings*, 4to., London, 1833, pl. 14. BLANK DOOR.

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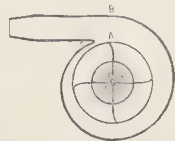
FALSE ROOF. The space between the ceiling and the roof over it, whether the ceiling be formed of lath and plaster, or be a stone vault. 2. 23.

FALSE WINDOW. A BLANK WINDOW, that has glass inserted, the wall behind not being pierced.

FAMIN (A...), born 1780 at Paris, obtained 1801 the *grand prix*, by a design for a triumphal arch, engraved in LONDON, *Annales*, 8vo., Paris, v, 68; gained 1806 a medal for his drawings, exhibited conjointly with Grandjean, of the arch of Trajan at Benevento and of the temple to Minerva at Assisi; and received the second prize for the design for a monument to General Desaix. He published with A. Grandjean de Montigny, *Architecture Toscane*, fol., Paris, 1815, the first seventy-three plates, but being engaged in other undertakings, the remaining thirty-six plates were executed under Grandjean alone; the work was reissued 1846. The illustrations of two houses numbered 10 and 12 in the rue Neuve de Berry at Paris, given by NORMAND, *Paris Moderne*, fol., Paris, 1837, i, 33-4, have Famin, 1827, attached to them.

FAN. In applied mechanics, the name 'fan' is used to designate the machine used for the purposes of procuring a powerful current of air, for melting iron in the cupola furnace, for smiths' forges, or occasionally for ventilation and for drying purposes. Fans of this description consist usually of a shaft, bearing a series of arms, upon which are fixed the sails or blades, working in a close box of a peculiar helicoidal form, and able to receive, through an opening around the bearings of the shaft itself, the air to be from thence expelled through a passage susceptible of being directed and regulated as may be required. According to the purposes to which the draught thus produced is to be applied, the velocity of revolution of the fan, and the pressure of the air at the outlet are made to vary in every conceivable manner; but the following observations may be considered to express, in a concise form, the results of the most trustworthy experimental researches into the best forms and proportions to be given to these machines.

The radius of the opening at the centre *r* for the admission of air being considered as the unity of the other parts of the machine, the depth of the blades, usually four in number, is made equal to *r*, so that the diameter of the circle of revolution



of the tips of the blades equals $4r$: the width of the blades is made equal to $1.5r$. The outer case takes the form of an arithmetical spiral curve, starting from the circle of revolution at *a* (with the necessary allowance for the play of machinery, and with the rounded corner to be referred to hereafter), and ending at the point *b*, in a horizontal line tangential to the curve itself; the distance between the points *a* and *b*, measured in the interior, being equal to *r*, with the usual allowance for play; or, in other words, the area of the entrance to the outlet pipe is rather larger than that of the blades. The outlet pipe is continued for some distance in a perfectly parallel form, but when the blast obtained by the use of the fan is intended to be applied for smelting, or for analogous purposes, the nozzle is usually contracted in order to increase the pressure of the blast; when fans are used for the purpose of removing vitiated air, the end of the outlet pipe is, however, made with a species of bell mouth. It is supposed that an advantage is obtained by making the blades curvilinear; but it is to be feared that the centrifugal force produced by the velocity of revolution may cause the blades to straighten. A very great advantage is gained by rounding the lower end of the outlet pipe, at *c*, for by so doing less resistance is offered to the escape of air, and the noise of the fan will be almost entirely obviated. A fan similar to the one thus described, and having blades of 5 ft. diameter, will be found to produce the most useful results when it makes about 1050 revolutions per minute; and, with that velocity of revolution, the air at the outlet will

escape with nine-tenths of the velocity of the centre of the blades, producing a blast equal to about 7 ins. of water, or rather more than four ounces per square inch. The useful effect of any motive power, employed for this purpose, cannot be considered to exceed from 0.60 to 0.70 per 1.00; a fan like the one mentioned would thus require an indicated horse power of above fourteen horses.

When it is required to withdraw large quantities of air for the purpose of ventilation, the diameter should be largely increased beyond that above mentioned, and consequently the speed may be diminished. It is by no means rare to meet with fans of this description of 20 ft. diameter; but even with them the relative proportions above quoted of the parts should be observed. In all cases it must be observed that air, when set in motion by a fan, follows the dynamical laws of the whole class of imponderable fluids; and that it is subject to precisely the same class of interferences as they meet with from the shape and nature of the tubes to be traversed, and from the contractions so produced of the vein. It follows, therefore, that the inlet or draught should be as close as possible to the working part of the machine; and that the discharge pipe should be short, and free from curves or abrupt changes of area. *Detached Essay, VENTILATION*; PEULET, *Traité de la Chaleur*, 8vo., Liège, 1845; TOMLINSON, *Cyclopædia of Useful Arts*, 8vo., London, 1854; BUCKLE, *Experiments on the Fan Blast*, in the *Transactions of the Institution of Mechanical Engineers at Birmingham*, 1847, also given in the *Civil Engineer Journal*, x, 190-1, and xi, 18-22. E. COWPER's unpublished Experiments on Fans have been made available for these remarks. BRUNTON's VENTILATOR; PUNKAH.

G. R. B.

FAN. A term lately introduced for the horizontal boarding used over the hoarding of houses about to be pulled down in narrow thoroughfares, for the protection of passengers.

FANCELLI, not FANELLI nor TANCELLI, as it has been printed (LUCA), was son of Jacopo di Bartolommeo of Settignano. He built at Florence the palazzo Pitti under F. Brunellesco, who is called his teacher by MILIZIA, and amongst other edifices the capella maggiore of the church 'della Nunziata' under L. B. Alberti, according to the same author following VASARI (who calls him Salvestro in v. *Alberti*), but this last work was superintended by A. Manetti according to GAYE, *Carteggio*, 8vo., Florence, 1839, i, 238-9. Fancelli was afterwards much employed at Mantua, where he settled and founded the family of the Luchi; he was living there 1486 according to GAYE, who, 300-3, gives letters dated 1490 from Lorenzo de' Medici to Francesco Gonzaga asking that Fancelli might go to the duke of Calabria; and notices that Fancelli's appointment, 17 September 1491 to be *capo-maestro* of the cathedral at Florence as successor to Giuliano da Majano, calls him Luca da Settignano.

FANCY. The exercise of the imagination independent of the reason or judgment: fancy supplies forms without reference to the *rationale* of their composition; invention combines forms already existing with special reference to their propriety of application either individually or in mass. Arabesque and conventional ornament are works of fancy, while pictorial and sculptured compositions are works of invention. H. B. G.

FANCY COLOUR or EXTRA COLOUR. The name given by house painters to any colour except the common ones, viz. white, black, lead, chocolate, or stone, colour.

FANE, see VANE.

FANE (Lat. *fanum*). While the Latin *templum* required the intervention of the augur, and was not necessarily what is understood by a temple; the word *fanum* had more especial reference to the ground itself. Romulus vowed a temple to Jupiter Stator, "sed fanum tantum id est locus templo effatus jam sacratu est" is the observation of LIVY, x, 37, which BURGESS, *Top. of Rome*, 8vo., London, 1831, i, 274, translates "a spot consecrated for a temple by a set form of words: so that the ground about a sepulchre enclosed and consecrated

might be called a fane. They were accustomed to leave a small space in front unconsecrated, into which the people might enter at pleasure:—this was the *locus profanus*, meaning it was before the fane.—There were at Rome a few fanes, as of Carmenta, Febris, Hercules at the porta Capena, Rediculus in the via Appia, of Venus Murcia, and one in the Vatican." Aurelius Victor, in v. Maxent., calls the temple of Venus and Rome, a fanum. CICERO, *Ep. ad Attic.*, xii, 35, 36, uses the word fanum rather than sepulchre for his monument to Tullia. The Christian writers, although they applied the words *naos* and *templum* without aversion to a church, when they could safely use them without being mistaken for a heathen temple, abstained from using *fanum* except as a term of contempt: BINGHAM, *Origines*, 8vo., London, 1840, ii, 346.

FANE (JOHN), seventh earl of Westmoreland (1736-62), is named by MILIZIA as architect of the mansion, then called the Rotunda, but now Mereworth Castle, near Tonbridge in Kent; whereas the house, after the pattern of the rotonda del Capra, with detached wings, was the work of C. Campbell; MILIZIA, *Lives*, 8vo., London, 1826; NEALE, *Views*, 2nd series, 4to., London, 1825, ii.

FAN GROINING, see FAN VAULTING.

FANLIGHT. In arched doorways having doors only up to the springing, the semicircular void was formerly filled with open ironwork or with glass divided by wooden or metal bars frequently resembling the sticks of a fan, hence this name for the opening. The glazed opening, whether semicircular or square, over the door, is still called a fanlight though now usually filled with a single sheet of glass, the bars being omitted. GRILLE.

This term is spelt *fawn-light* in Scotland, according to a notice in the *Quarterly Review*, 8vo., Lond., 1854, xcvi, 120.

FANO, the Latin Colonia Julia Fanestræ, or Fanum Fortunæ. A city in the legation of Urbino and Pesaro in the Papal States. The walls and towers enclose the ruins of the porta Augusta or porta Maggiore, published by MANCINI, *Illustrazione dell' Arco di Augusto*, 1836, at the time of a projected restoration. The principal buildings, besides the cathedral dedicated to the B. V. Assunta, are the adjoining episcopal palace, restored 1637-88; the tower in the square piazza; the palazzo Comunale, Governativo, di Sta. Croce, de' Ferri in the piazza di S. Antonio, and Manchini; and the theatre (formerly the palazzo della Ragione) a work of the thirteenth century; and the teatro della Fontana which, erected 1671 by G. Torelli, appears to have been somewhat recently rebuilt: its name arises from the highly praised fountain surmounted by a figure of Fortune. There are thirteen parish churches, six monasteries, and four convents, amongst which should be named the monastery of the canons regular and their church of S. Paterniano, a magnificent work by Sansovino, the campanile being one of the finest in the Papal States; the great monastery of S. Francesco; the Dominican church built 1240, restored 1334, and modernized 1702; the new church dei Conventuali; that of Sta. Maria Nuova, belonging to the Minori Osservanti, 1551; and the Jesuit college finished 1673 from the design of a padre Serafino, with its church built 1685-6 from the design of (Carlo?) a son of Girolamo Rainaldi, according to AMIANI, *Memorie*, fol., Fano, 1751, ii, 299. The founding hospital of S. Michele near the Arco, is perhaps the only other edifice deserving notice, except the Camaldolese church at the Eremo di Monte Giove, about two miles from the city. It was for this town that Vitruvius designed and executed the basilica, described in the first chapter of his fifth book on architecture: the latest restoration of this design is given by VIOLETTE LE DUC, *Entretiens*, 8vo., Paris, 1858, i, 150-7, pl. 8-10. 28. 96.

FAN PATTERN. One of the ceilings at Vulci "has a singular fan pattern, the counterpart of which is found in two tombs at Cervetri"; it is given in *Mon. ined. Inst.*, i, pl. 41, according to DENNIS, *Cities*, etc., 8vo., London, 1848, i, 408, ii, 33, 57.

FANSAGA or FANSAGO (COSIMO or COSMO), born 1591, probably at villa d'Ogna, but certainly in the township of Clusone near Bergamo, whence he is sometimes called Cosimo da Bergamo. He was a pupil of Pietro the father of G. L. Bernini at Rome, where he modernized the church of S. Spirito de' Napolitani in the strada Giulia, and added a new façade to it. Having settled at Naples, he there practised more as a sculptor than as an architect, but amongst his works may be enumerated, according to DOMENICI, *Vite*, 8vo., Naples, 1843, iii, 381, a cloister in the Benedictine monastery of SS. Severino e Sossio, with the refectory 260 ft. long and 62 ft. wide, and the high altar of its church; the high altar 1603 in the church of the Madonna di Costantinopoli; the *atrio*, inner door, and steps to the Benedictine nunnery of S. Gaudioso; the façade and steps to the church of the Dominican nunnery of Sta. Maria della Sapienza; the chapel of S. Francesco Saverio, and the staircase in the college called il Gesù Vecchio, afterwards il Salvatore; the high altars in the churches called Sta. Maria la Nuova and Sta. Annunziata; the altar of Sta. Maria delle Grazie in the church of Sta. Chiara; the modernization of the Galeoti chapel in the duomo; the *atrio*, church, and convent of Theresine nuns of S. Giuseppe a Pontecorvi; the façade to the Jesuit church of S. Francesco Saverio (but SIGISMONDO says the college and church afterwards made parochial and called S. Ferdinando) 1628 in front of the palace; the façade and steps (SIGISMONDO says the church) of Sta. Teresa 1650-62 for the padri Carmelitani Scalzi; the alteration of Domenico d'Auria's work called the fontana Medina, and its removal to the largo del Castello; the fontana Fonseca in the street leading from the palace to the church of Sta. Lucia a Mare; the presses for the sacristy of the Jesuits; the steps and great portal to the palazzo Maddaloni or Mataloni; the façade to the church of Sta. Maria degli Angeli (SIGISMONDO says the church, *atrio*, and monastery) 1639 for the Frati Riformati di S. Francesco d'Assisi; the Cacace chapel in the church of S. Lorenzo dei Padri Minori Conventuali (to which SIGISMONDO adds the chapel of S. Antonio di Padova, formerly called cappella della Regina, on the Gospel side in the same church); the church called dell' Anime del Purgatorio in the strada ad Arco; the bronze door weighing about 27,000 lbs., commenced 1623 and 1668 at a cost of about £3,200, to the chapel called il Tesoro di S. Gennaro; the *guglia* or pillar of S. Gennaro, commenced 1637 and finished 1660, at a cost of about £2,800, opposite the church called della Misericordia; the marble enrichments of the cloister with its sixty columns in the Carthusian monastery of S. Martino; the *cimiterio* and the great *conserva dell' acqua*, which he rendered a handsome work of architecture; the high altar with the great chapels of S. Ignazio and S. Francesco Saverio in the church called il Gesù Nuovo afterwards the Franciscan church of the SS. Trinità Maggiore; and the façade, gate, *atrio*, stairs, and pulpit to the Franciscan church of the SS. Trinità alla Monte di S. Martino, besides the modernization to a considerable extent of the church itself, built by P. Francesco Grimaldi, with alterations and additions to the nunnery. Several palaces are said to have been designed by Fansaga, who towards the end of his long life (87 years) was chiefly engaged in making designs and models, and in giving advice upon the execution of difficult works in sculpture and architecture. At his death he left unfinished the completion of the church of S. Niccolò alla Carità, called S. Nicolliello, commenced by Onofrio Gisolfi or Grisolfi for the Padri Pii Operarij, for whose noviciate the church of Sta. Maria de' Monti had been erected 1607 by Fansaga, and for whom 1640 he began the church of S. Giorgio Maggiore in the strada a' Mannesi; and commenced 1657 the base of the statue of S. Domenico (which was finished 1737 by Domenico Antonio Vaccaro) in the piazza di S. Domenico. He was buried 13 February 1678 in the church of Sta. Maria d'Ognibene.

In addition to these engagements SIGISMONDO, *Descr.*, 12mo., Naples, 1788, adds the altar and tribune 1672, finished by the

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Mozzetti 1682, of the Carmelite monastery of Sta. Maria del Carmine; the high altar 1639 in the church of S. Domenico da Soriano; and that, afterwards altered by Naclerio, in the church of S. Domenico Maggiore or de' Padri Predicatori, besides the design for the church of Sta. Maria Maggiore or la Pietra Santa 1654-67, esteemed one of the finest in Naples. After quoting the above and noticing that the author of the *Roma Antica e Moderna*, 12mo., Rome, 1745, says the façade to the church of Sta. Maria in via Lata (not so stated in this edition), and i, 435, the pulpit at the church of S. Lorenzo in Lucina, are attributed to the cavaliere Cosimo da Bergamo, TASSI, *Vite*, 4to., Bergamo, 1793, ii, 15, corrects the error made by SCARAMUCCIA, *Finezze*, 4to., Pavia, 1674, p. 72, who calls him Cosimo Fonseca of Brescia: in this error of Brescia, SARNELLI, *Guida*, 12mo., Naples, 1708, p. 104, is followed by ORLANDI, *Abecedario*, 4to., Bologna, 1719, p. 124, and others, indeed the *Serie degli Uomini* contains varying notices of Fansaga and Fonseca: TITI, *Annaeustramento*, 12mo., Rome, 1686, simply styles him Cosimo the Neapolitan.

The following notes regarding this fortunate artist are also supplied by TASSI: Fansaga designed 1634 the high altar, in the Benedictine church of S. Niccolò del Lido near Venice, on which the names of himself and the two executants Giovanni Andrea Lazzari and Giovanni Battista Galli are inscribed; and probably was the designer of the octagonal church of the B. Vergine delle Neve, outside the porta di borgo S. Antonio at Bergamo; GHIRARDELLI says that the unfinished octagonal church of Sta. Maria del Monte Santo, or del Monte di S. Giovanni, at that city, was commenced in consequence of the pestilence of 1630 from a design made by Fansaga for the church to the Theatine monastery of Sta. Agata; PASTA, *Pitture*, intimates that the same artist designed the church of the Madonna with its superb loggia on the north and west sides, in the borgo di Sta. Caterina at the same city. Lorenzo Vaccaro was his best pupil.

3. 30. 95. 111.

FAN SHAPE. This term is used by WHEWELL, *Arch. Notes*, 8vo., Cambridge, 1842, p. 110, who, speaking of Transitional or Early German Pointed Art, says that "a window which is frequently found and peculiar to this style, is a fan-shaped window, which may be described as the upper part of a circle (more than half), of which the circumference is cut into round notches. This obtains in the clearstory of Sinzig, and of the dome of S. Gereon—in the side aisles of Bonn, S. Cunibert, S. Gereon, and Notre Dame at Coblenz."

FANUM, see FANE.

FAN VAULTING. A very beautiful method of vaulting or groining over a building, used in the Perpendicular style of mediæval architecture, and said to be peculiar to England. The voussoirs commence at the springing concentrically on plan, and proceed to the centre, cutting into each other, and very frequently finishing with a large pendent which forms a sort of key-stone. The under surfaces are therefore all curved each way, and are not plane in any section like ordinary vaulting. In fact they in some degree resemble pendentives, and meet together at the centre of the bay like portions of domes. It is usually very rich, not only having a great many ribs, both direct and lierne, but also cusplings, eyelets, etc.: from the divergency of the ribs, which resemble the sticks of an open fan, this work has its name.

A very admirable article, going very fully into its construction, by Professor WILLIS, is given with elaborate illustrations in the *Transactions* of the Royal Institute of British Architects, 4to., London, 1842. The finest specimens are at Trinity chapel, Ely; King's College chapel, Cambridge; S. George's chapel, Windsor; Henry VII's chapel, Westminster; and there are many examples at Canterbury, Gloucester (where it is supposed by WILLIS to have originated, *BUILDER Journal*, 1860, xviii, 560), Peterborough, etc. The tracery on these vaults is particularly varied and beautiful. WHEWELL, *Arch. Notes*, 8vo., Cambridge, 1842, p. 79, mentions the vaulting of the

Lady chapel at Wells as being octagonal concavo-convex; proceeds to give names to each detail, such as diverging veins and concentric bands forming the panels of the vaulting, the ridge-lozenges; and in polygonal vaulting of this nature he speaks of a ceiling as covered with reticulating ribs. Among the later examples is that to bishop West's chapel at Ely, cir. 1533, carried out in the Italian style, given in *Illustrations*, 1857-8, s. v. CEILING; the crypt of Lincoln's Inn chapel, London, vaulted in stone, 1623; and the fine Gothic staircase of Christ-church College, Oxford, 1640.

FAN WORK. This term occurs in the following passage from DALLAWAY, *Anecdotes*, 8vo., London, 1800, p. 25, "the almost infinite reduplication of a small vault, springing from four semicircular groins at the angles, which rest upon pilasters. For this kind of fretted roof upon a diminutive scale, the term 'fan-work' has been used—an idea suggested perhaps by a certain resemblance to that shape, as spreading from the base."

Fan work of wood sometimes occurs, as in the cloisters at Lincoln, and in the chapel of Wykeham's College at Winchester.

FAREY'S DOUBLE BALL COCK, rewarded by the Society of Arts, etc., is explained in the *Transactions*, 8vo., London, 1818, xxxv, 175. Its merit consists in the tap ball being dropped beyond the axis of the cock, and being pulled over that axis by a secondary ball, when the water has arrived at any required level, so that the flow of water is at once arrested.

FARKID BEN AUN, EL ADUANI, of Cordova, constructed (A.D. 793) the beautiful fountain which, from his name, is called Ain Farkid. This, considered to be one of the most exquisite structures in Cordova, was erected solely for the gratification of king Hixem Ben Abderahman: CONDÉ, *Dominion of the Arabs*, 12mo., London, 1854, i, 237.

FARLEIGH (RICHARD DE), is styled 'builder' by Dops-worth, *Salisbury Cath.*, 4to., London, 1814, p. 151-8, noticing an agreement July 1334 with the chapter of Salisbury cathedral for the custody of the fabric, to order all work, and to superintend, direct, and appoint useful masons, etc., notwithstanding his prior obligations at Bath and Reading. He was to receive 6d. per day when he was present, and ten marks quarterly as custos of the building, in case he survived 'Robert the builder'. He is presumed to have designed or executed the upper part of the tower and the spire, with the other necessary works.

FARLEIGH DOWN STONE, obtained from the quarries at Monckton Farleigh near Bath in Somersetshire, is composed chiefly of carbonate of lime in oolitic grains of moderate size, and is of a cream colour, may be sawn dry, and rapidly decomposes. It is stated to have been used in the old parts of Buckingham palace, and in the works executed from 1821 to 1840 to the north side of Westminster abbey; also in S. James's-square, Bath. BATH STONE.

FARM BUILDINGS. So much, as is known, of the names of the different divisions of a farm house with its offices and outbuildings among the Romans, is given in SMITH, *Dict. Ant.*, s. v. Agriculture, under the head *Villa Rustica*.

Mediæval farms are referred to in VERDIER and CATTOIS, *Arch. Civile*, etc., 4to., Paris, 1852; *Revue Générale*, 1849, viii, 8; in VIOLETTE LE DUC, *Dict. i*, 275, etc., and s. v; PARKER, *Domestic Architecture*, etc., 8vo., London, 1859, iii, 329; and s. v. BARN, in this dictionary.

FARM BUILDINGS (ARRANGEMENT OF). Buildings required for the various operations of husbandry, consisting of storehouses for grain and other agricultural produce; stabling and shelter for horses, cattle, and other stock; and accommodation for threshing and otherwise preparing the produce for the markets. The arrangement and character of these buildings differ in a variety of respects; first as to the character of the husbandry—whether on the most improved system or otherwise—and the usages of certain localities; and secondly as to the peculiar character of the operations themselves, whether as tillage, dairy, stock, or otherwise.

In designing a building, in which a series of operations are

proposed to be carried on, whether these be connected with a manufacture or with farming, it is of importance to bear in mind two points; first, that it is necessary to have a thorough acquaintance with the nature of those operations; and secondly, with the sequence or order in which they succeed each other; so that the material used shall go regularly through a series of apartments, from the first stage to the last; that there shall be no returning from one point to another, in order that the utmost economy of time and space shall be attained. The existence of many steadings ably designed is not to be ignored, but in others, not only are a variety of apartments huddled together without reference to the connection which the various processes carried on in them had one with another, but there are apartments, some of which are not at all required, others, to say the least, superfluous. To procure the names of a number of apartments used in farm buildings, and to arrange them so as to form a plan symmetrical or otherwise, is not to design a "farmery," a "farm-stead," "onstead," "farm buildings," or a "home-stead," for by all these names are the buildings of a farm designated.

It is impossible, within the prescribed limits of this article, to explain the peculiarities of all the modes of farming practised in the kingdom; reference will therefore be made to three only—namely, the *Grazing and Sheep or Hill*, the *Dairy*, and the *Mixed Systems*. These, however, may be taken as comprising the types of all others, the *mixed system* more especially, being an embodiment of every mode practised throughout the country. The *Grazing and Sheep System* is determined by locality; where high mountain ranges are alone met with, sheep only are reared; where lower ranges occupy part of the farm, cattle are reared. The stock accommodation of the building required where both cattle and sheep are reared, has usually reference to the cattle alone, this being of a simple nature, providing for their winter shelter; no winter house accommodation is required for sheep, special shelter being, however, sometimes provided for those in the uplying districts. These shelters are called "stells," and are simply enclosures formed with low stone walls, and provided with small entrances. These enclosures assume different shapes, according to the fancy of the builder or the notions he entertains, as to the shelter required to be afforded by them. STEPHENS, *Book of the Farm*, 8vo., London, 1849, has figured several forms. Where a *grazing and sheep farm* is provided with land suitable for arable culture, building accommodation is then required for the various processes connected with the latter.

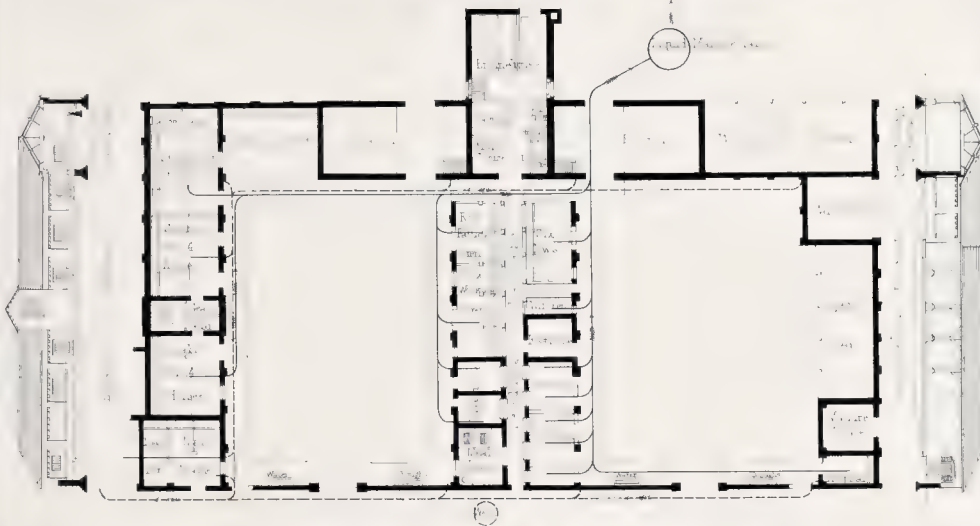
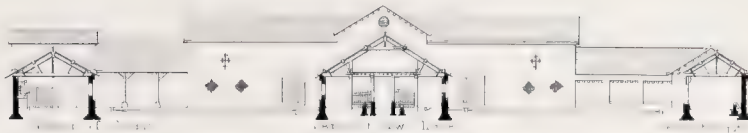
The *Dairy System* is principally determined by locality, attention being paid to the proximity of the farm to a market. It requires—for the production of milk, butter, and cheese—a certain extent of pasture and meadow, and of arable land for the raising of produce for winter and spring consumption. The building accommodation of a dairy farm has reference to the "stock," and the apartments connected with the making of butter and cheese, and the storing and working of the products of the arable part of the farm.

The *Mixed System* is generally independent of locality; its principles of operation enabling it to be adapted to almost any place or circumstances of locality. The rearing and fattening of stock, with the treatment of the arable land, and all their attendant processes, are happily combined under this system. On a farm of this kind, grain and roots are raised; cattle and sheep, pigs and poultry, are bred, reared, and fattened; while the dairy products are not overlooked, as milk, butter, and cheese. The building accommodation required, therefore, is of a very complete and multifarious description.

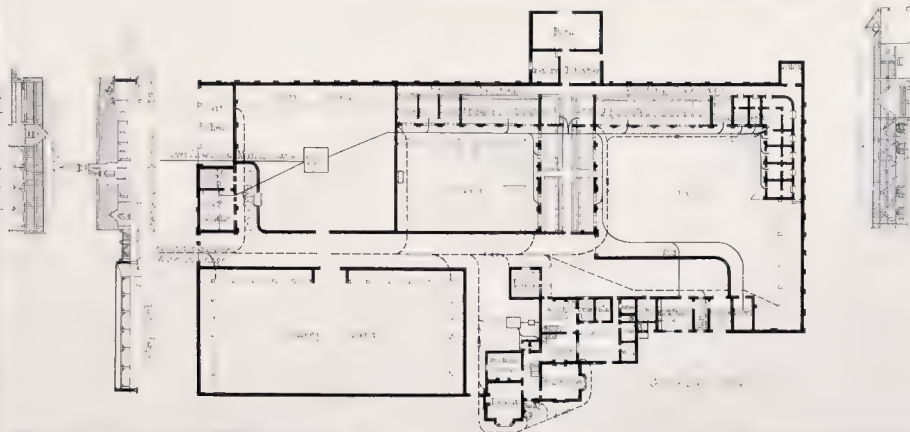
Before proceeding to give outline plans, in which the necessary accommodation required to carry on farms on the three systems above described is illustrated, it will be well to explain the "principles of position and arrangement," applicable to certain modifications of them. First, as to the question of site. Obviously the centre is the best situation, but this will be modi-



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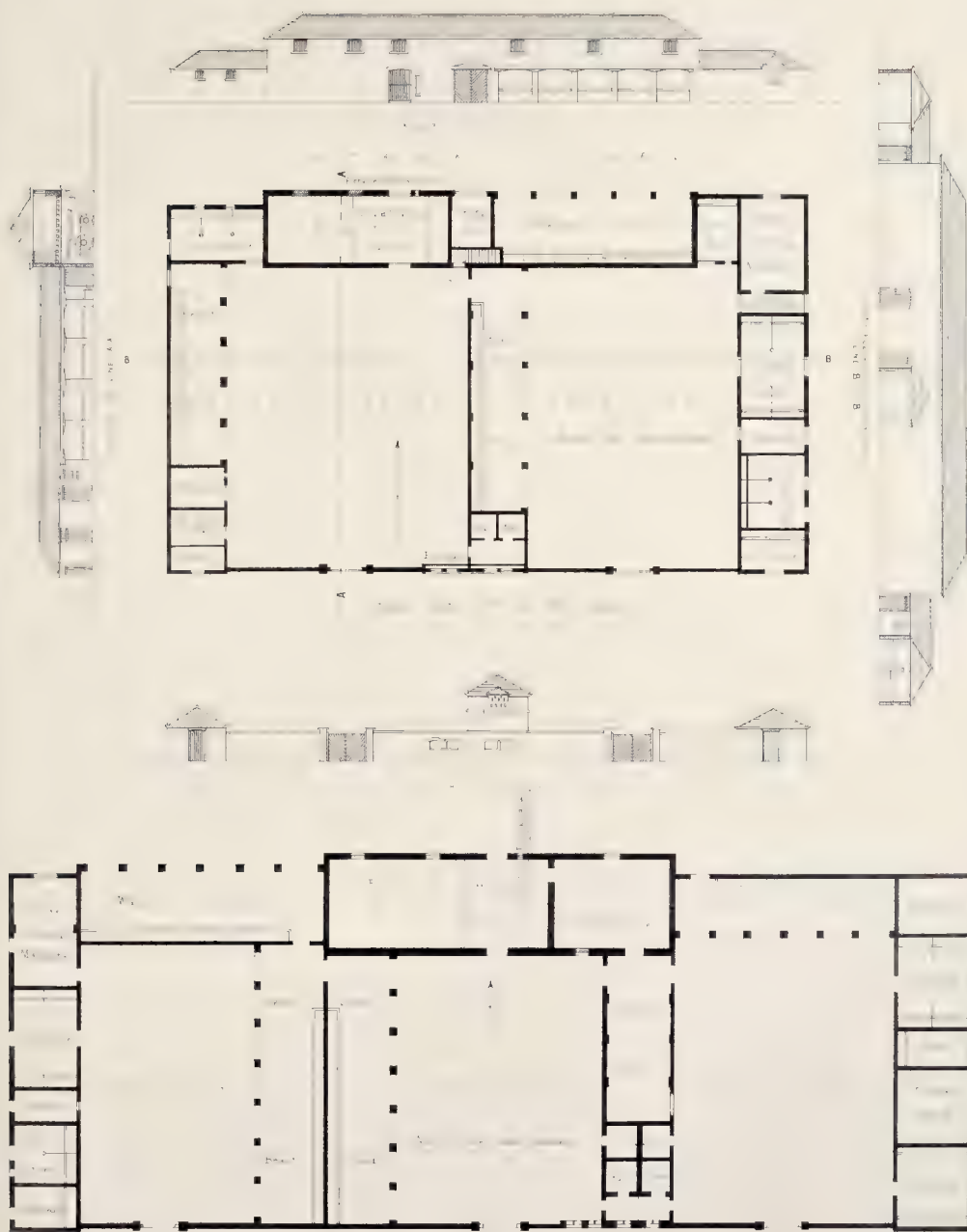


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AGRICULTURAL BUILDINGS

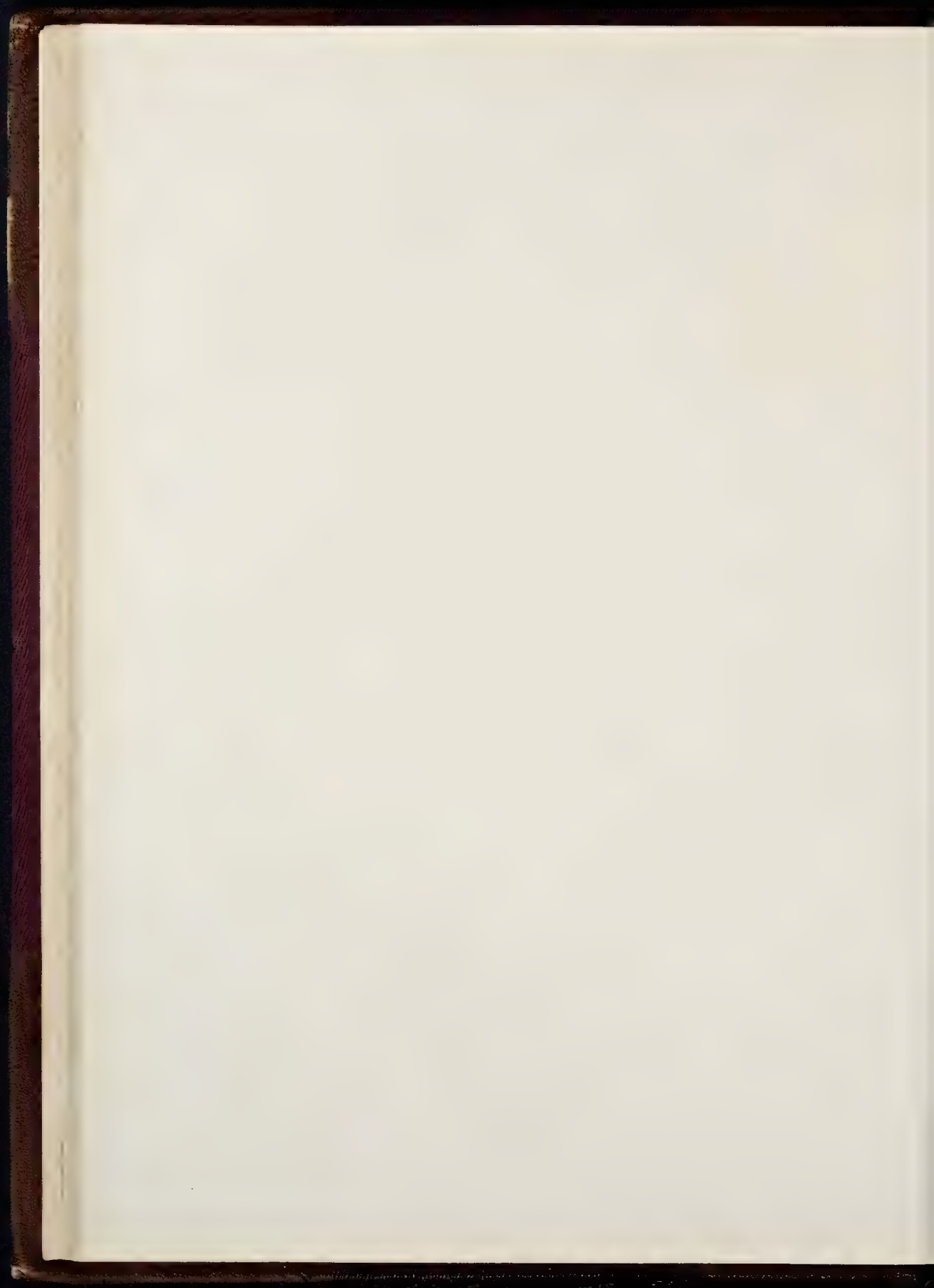


Farm from 400 to 600 Acres

Plans for Buildings, &c. &c. &c.

SCALE

Lithographed by Vincent Brooks King St. Covent Garden, October 1857.





fied by circumstances. A plentiful supply of good water may be obtainable at a point some distance from the centre, while none may be had there; this alone will put the central position out of the question. Before proceeding to set up the buildings the supply of water should be positively secured; if a brook or rivulet is not attainable, and well-sinking is necessary, this is the first operation to be effected. Where there is a choice between a comparatively low and a very high position, the former should be taken, as affording greater facilities for the transit and removal of manure, produce, etc. At the same time it is desirable to have the farm house—which should always be close to the working buildings—so placed on commanding ground, that a rapid view of the whole of the farm may be easily taken. A generally good aspect for the buildings is south-east, as the cattle courts, etc., will thus have the early sun to play upon them, as well as a large proportion of the day's sun. This, however, will again be modified by circumstances, as for instance, where from certain quarters storms most frequently blow, then the position of the buildings should be such as to shelter them from these prevalent winds. The best soil on which to build the farmery is gravel, the worst a retentive clay. Drainage will undoubtedly improve the latter, but it will never present such healthy advantages as the former.

Farm steadings are sometimes placed in bad positions because these command main roads, etc., already made. This is completely reversing the order of things. Roads, and all other minor appliances, should be made to suit the convenience of the steading, the convenience of the steading must not be sacrificed to suit them. It is needless to point out the danger of placing the farm buildings near marshy places, for these should have no existence in a well managed and well cultivated farm. At the same time it would be wrong to place buildings near or upon such places, however well and carefully they were drained.

Having thus discussed the question of "site and aspect," the second point to be taken up is "arrangement of the apartments" constituting the farm buildings; and upon this point it is difficult to improve upon the words of the writer before quoted (ii, 519-520), as follows: "Straw being the bulkiest article on the farm, and in daily use by every kind of live stock, and, although heavy and unwieldy, having to be carried and distributed in small quantities by bodily labour, it should be centrally placed in regard to the stock, and at a short distance from their respective apartments. The straw barn, its receptacle, should thus occupy the central point of the steading. The several apartments containing the live stock should be placed, in respect of distance to it, according to the wants of the stock for straw, in order to save labour in its carriage; for so bulky and heavy an article as straw should, in all cases, be moved to short distances, and not at all from any other apartment than the straw barn, so that the threshing machine, which deprives the straw of its grain, should be placed as at once to deposit the straw into the straw barn. The stack-yard, containing the unthreshed straw with its corn, should be contiguous to the threshing machine. The passage of the straw from the stack-yard to the straw barn, through the threshing machine, being directly progressive, it is a material consideration in the saving of time to place the stack-yard, threshing machine, and straw barn, in a right line.

"Different classes of stock require different quantities of straw to maintain them in the same degree of cleanliness and condition, so that these classes which require the most should be placed nearest the straw barn. The younger stock, including those in the hammels, requiring most straw, receiving it largely for fodder as well as for litter, the courts which they occupy should be placed next to the courts in nearness to the straw barn. Horses and cows requiring the smallest quantity of straw, the stables and byres may be placed next farthest in distance to the hammels from the straw barn. The position of other two apartments are necessarily determined by that of the

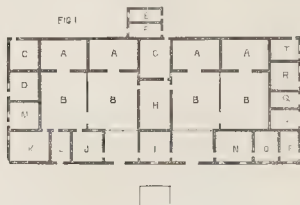
threshing machine, the one being the upper barn, which contains the unthreshed corn from the stack-yard ready to be passed through the mill, and the other the corn barn, which receives the corn immediately after its separation from the straw by the mill. The granaries should be in direct communication with the corn barn to save the labour of carrying the clean corn to a distance. . . . The granaries should always be elevated above the ground to keep the grain in good condition, and it enables their floors to form convenient roofs for cattle or cart sheds. The elevation, which the granaries give to the building, should be taken advantage of to place them so as to shelter the cattle courts from the north winds in winter; and in order to afford the warmth of the sun to the cattle all their courts should be open to its light and heat. The courts being open to the south, and the granaries forming a screen from the north, it follows that the granaries should extend east and west on the north side of the courts; and as it has been shown, that the cattle courts should be placed on each side of the straw barn, it also follows that the straw barn, to be out of the way of screening the sun from the courts, should stand north and south at right angles to the south of the granaries. The fixing of the straw barn to the south of the granaries, and of course to that of the threshing machine, one portion of the stackyard is necessarily fixed to the north of both, where it is favourably situated for the preservation of the corn in the stacks. The leading principle involved in the above arrangement is as comprehensive as simple, and is applicable to every size and kind of steading. But obviously correct as the principle is, it is seldom adopted in practice; and I may safely assert, that the greater the deviation from the principle, the less desirable steadings become as habitations for live stock in winter."

In addition to these principles others may be named of considerable if not of equal importance. Thus it will conduce greatly to the economization of time and labour, if all the apartments connected with one branch be kept close together; thus in the case of a dairy farmery, where the apartments connected with the dairy are mixed up and blended with those connected with the arable department, loss of time through confusion and clashing of opposing processes will inevitably ensue. Again it will conduce to this essential economy of time and labour, if the apartments of any one department be so arranged that the various processes carried on in them shall have a connection one with another. Thus the hay house should have a close connection with the stables where it is consumed; and the turnip and cake stores, with the cow house and the cattle feeding apartments, in which they are used; and to these instances may be added this one, that the apartment in which food is prepared for stock shall be near at hand both to that where the food is stored and to those in which when prepared it is consumed. The place where the manure is stored should obviously, also, be easily reached from the apartments in which it is produced, as the stables and the cattle houses.

After thus having explained as briefly as possible the principles which should guide the architect in placing the farm buildings and in arranging its various apartments, illustrations of examples will now be given adapted to the three systems of farming, namely, the *Grazing and Sheep*, the *Dairy*, and the *Mixed Systems*.

Fig. 1 represents an outline plan of a *grazing and sheep*, or *hill farmery*. This, in the way it is given in the figure, is illustrative of a steading where both sheep and cattle are reared, and arable culture conducted; but the same illustration will suffice to explain the accommodation required for the different classes of this kind of farming. Thus, where no arable culture is carried on, but the stock accommodation of the steading required being only winter shelter sheds for cattle, and for the farmer, apartments for his horses and cows, etc., the arrangement may be as follows. Take out the central apartments marked G, H, I, make the corn barn the same length

as the width of the cattle courts and sheds marked A, A, B, B. The farmer's accommodation required will be placed in the two



wings. In one wing will be the following apartments: c, the killing or slaughter house; d, the out-house for holding odds and ends, etc. The apartments marked L, (guano store) and M, (infirmary) will be done away with, and their place occupied by the cow house K, and the turnip store J; a poultry house will be placed between the out house D, and the cow house K. The cart shed will occupy the apartment G, left between the cattle shelter sheds. The other wing will have the apartment marked R, (implement house) taken out, and the following will make up the accommodation. Gig house Q; riding horse stable P; hay house O; and cart horse stable N. The following then will be the accommodation in the *grazing and sheep farmery* where cattle are reared and no arable culture undertaken. First, shelter sheds and cattle courts, as many as are required, four in the illustration; secondly, slaughter house; thirdly, out house; fourthly, poultry house; fifthly, cow house; sixthly, turnip store; seventhly, gig house; eighthly, riding horse stable; ninthly, hay house; and tenthly, cart horse stable.

Where arable culture is undertaken, and cattle and sheep are reared, the main features of the building as above described will be retained, and additions made, to lengthen the central part, and add two wings, which will run parallel to the shelter sheds A, A, A, A. The whole, as shown in fig. 1, will thus be enclosed in a parallelogram, the entrances being at the gates. The following will be the accommodation: *x*, boiler house; *y*, steam engine house (if the farmery is small, the threshing machine may be driven by a horse gear apparatus, or by means of a fixed horse wheel with a covered house); *a*, corn barn; *n*, straw barn; and the granaries extend over the cattle sheds; *i*, boiling house for cooking turnips, preparing mashes, &c.; *j*, turnip and food store; *k*, the cow house; *l*, artificial manure store; *m*, cattle infirmary; *d*, out house; *c*, slaughter house; *n*, work horse stable; *o*, hay house; *y*, riding horse stable; *q*, gig house; *r*, implement house and work shop; *s*, cart shed; and *t*, poultry house. Where sheep are reared a wool room is necessary; this may be placed above the boiling house, *t*, to be entered from stairs within this room, or placed outside at the ends. The dung store, with liquid manure tank under, is placed at *u*.

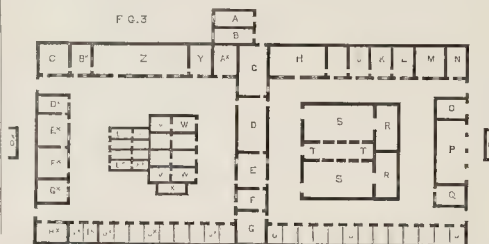
Fig 2 is an illustration of a *dairy farmery*. A, engine boiler house; B, steam engine house; C, corn barn; D, straw barn; E, oil cake store; F, the food boiling house; G, turnip store and fodder house; H, H, cow house; I, calf house; J, washing house, in which the dairy utensils are scalded and cleaned; K,



milk house ; L, churning room ; M, cheese and press room ; P, fodder cutting room, in which the hay and roots are cut ; it

is placed in this position that the power of the steam engine may be used to work the root and hay cutters. The shaft for communicating power to these from the engine may be continued on to the next apartment, and power obtained to work the churn. In this case the cheese room M, will be removed further on, taking the place of the churning room now marked 1; a turnip and oil cake store is placed at o; a workshop at n. On the other side of the central part are placed the following apartments: q, r, cattle boxes for rearing young cattle; s, t, bull boxes; u, v, piggery; v, poultry house; w, turnip and fodder store; x, out house or implement shed; x, infirmary; z, gig house; A*, cart shed; B*, riding horse stable; c*, hay house; D*, work horse stable; E*, E*, manure sheds, with liquid manure tanks below.

Fig. 3 is an illustration of a *mixed farmery*. A, boiler house; B, steam engine house; C, corn barn; D, straw barn; E, boiling root house; F, corn and cake store; G, turnip store, wool room over; H, work horse stable; I, hay house; J, riding horse stable; K, boiling house for mashes; L, corn crushing and store room, oil cake may also be crushed in this apartment; M, implement house or work shop; N, poultry; O, gig house; P, cart shed; Q, artificial manure store; R, R, shelter sheds; S, S, courts for fattening cattle; T, T, turnip store, the turnips being fed to troughs placed in the courts, through shot-holes made in the walls of the turnip store U, U and V, V, V, cattle boxes. In the other division of the building are the hammels for feeding young cattle, occupying the corresponding place



to the courts and sheds. These hammals are composed of v, v, small sheds with courts, w, w, these being provided with water and turnip troughs; x, is the turnip store; y, farmer's cow house; z, farm labourer's cow house; A*, calf house; B*, root boiling house; C*, turnip and fodder store; D*, washhouse for scalding dairy utensils; E*, milk house; F*, churning room; G*, turnip or root store; H*, infirmary; I*, bull boxes; J*, J*, J*, cattle boxes; K*, K*, L*, L*, piggeries; and O*, O*, manure or dung stands.

The scale to which these illustrations are drawn is 80 feet to the inch. It is not professed to give accurate sizes to all the apartments; the diagrams being prepared simply with a view to show general proportions, and to elucidate the principles of arrangement as propounded. Fig. 3, for instance, contains every apartment essential to a very large farm, although the size of each might require to be modified according to circumstances.

Space does not allow of a full analysis of these plans. The way in which the leading principles enunciated in the previous part is carried out in the *mixed farmery* in fig. 3 may be thus described. The stack or rick-yard being placed to the north of the buildings, and the corn-barn c nearest it, the corn is taken to the threshing-floor above c, threshed, and the straw delivered at once to the straw-barn d. The straw taken from this is delivered to the cattle-courts s, s, and sheds r, r, on one side, and to the hammels for young cattle v w on the other. It is also as easily delivered to the range of cattle boxes u, v, u, j*, j*, j*, on the south side, and to the work horse and riding horse stables h, j, and to the cow-houses y and z, and calf-house A* on the north side of the building. The boiling-

house *e* is supplied with oil cake or corn from *f*, with turnips from the store *g*, and with straw from barn *d*. The hay-house *i* supplies right and left the stables *h* and *j*; while the boiling house, and corn, and cake-crushing room are close at hand. The work or tool-house *m* is close to the gig-house *o*, and cart shed *p*. The cattle courts *s*, *s* are supplied with turnips from the store *t*; while the cattle boxes *u*, *v*, *u* are supplied either from this or from the turnip store *g*. Taking the range on the other side of the central building, the boil-house *b** supplies the two cow houses *z* and *y* through the doors; while the supply of turnips to be cooked is taken from the store *g**. The dairy apartments are put in the western range; *b** being the wash-house; *e** the milk house, the churned milk and whey being at once carried off to the piggeries. The turnip stores at *g** and *v** supply the hammels *w*, *w*; cattle-boxes *j**, *j**, *j**, and bull boxes *i**, *i**, *i**. *h** is an infirmary for sick cattle. The dung produced in the eastern division is taken to the stand or pit at *o**, that from the eastern to the corresponding stand.

A point of considerable importance has been attained in the plans now presented, viz., the power of locking up the farmery at night; the gates being closed, all is self-contained. The position of the cattle-courts *s*, *s* has been reversed in the drawing. The sheds *n*, *n* should be nearest the straw-barn, so as to throw the gates nearest the dung stand on that side. As shown in the drawing, the dung from the courts, and the straw from the barn, would have to be removed a greater distance than if they were reversed. This shows the value of their position. The same remark applies to the hammels *w*, *w*; but as it was desirable to have the piggeries *x**, *x**, *x**, *x**, near the milk room *f**, the position shown in the drawing was decided upon; a better one, however, would be beyond the manure tank *o**, on the left of the building.

The progress of the bulky materials, straw, and roots, is thus regularly maintained from the starting point to the dung-stands, while the whole of the apartments connected with each other are all placed in close contiguity; the working part of the farm being on one side, the stock on the other.

Although the arrangement shown in the illustrations is not commonly carried out, in which all the sides of the farmery are made up of buildings, and where shelter sheds and cattle courts are placed in the central space, yet it is one which is largely on the increase. Several examples are met with in various parts of the kingdom; an excellent one is to be seen at Wark in Northumberland. Large central and open courts scantily, if at all, provided with shelter, are considered now to be behind the requirements of modern farming; manure-making on the old open system is now fast giving way to the systems of hammel, box, or stall feeding. If the complete enclosure as above illustrated is not desired, the arrangement of the apartments forming the south side of the steading as in fig. 3, may be altered so that they will form additions to the wings, the southern part being finished by a low wall or left open. The arrangement above illustrated is also obviously well adapted to that form, now so much advocated by some, in which the whole is covered with one roof; it is but right, however, to state that a wide diversity of opinion exists upon this point. On one matter the writer of this article has a very decided opinion, namely, that if the internal walls bounding the various apartments are not carried up to the roof, nothing but disappointment and loss will be the result. It should be remembered that farm stock are very delicate, and not the rough robust animals they are too often supposed to be; and that warmth and freedom from draughts are essentials, which in good feeding and housing cannot be obtained unless the internal walls are carried up to the roof. If they are not so built, cross currents and draughts will inevitably be created; and in the event of disease breaking out, the perfect isolation of stock cannot be secured. Again, on the score of economy in construction it is questionable whether the covered steading is the best.

It is a matter of extreme difficulty to lay down rules by

which the accommodation of farm buildings is to be proportioned according to the acreage or extent of the farm on which they are to be placed; circumstances of practice varying so much in various localities. Perhaps the best rule, for farms on the *Mixed System*, is that given in the prize essay by EWART, *Construction of Farm Buildings*, fol., London, 1851, and republished in his *Agriculturist's Assistant*, 8vo., Glasgow, 1857. He estimates the quantity of land to be prepared, and sown by turnips, as fifteen acres to each pair of horses. If then, cultivated on the five-shift system, a farm of 300 acres is to be provided with a farmery; 60 acres will be laid down in turnips, which, divided by 15, will give four pair; so that work horse accommodation will have to be given for eight horses at the least; to this will be added the riding-horse space. Of the 60 acres of turnips, say half are eaten off the ground by sheep, and half consumed by the cattle in the farmery; the number of cattle for which accommodation is to be provided, and to be maintained, will be from twenty to forty head, or say thirty, as that is one acre to each head of cattle. Bull house accommodation will have to be provided, as well as space for the milch cows, calves, pigs, and poultry. The size of the corn-barn and straw-barn will be pretty uniform in a wide variety of cases, as also the minor apartments. Locality and peculiarities of style of farming will, however, modify all such attempts at defining the extent of accommodation of a farmery; these will have therefore to be closely studied, and all information necessary obtained from his client, before the architect proceeds to make his design.

The necessarily defined limits of this paper preclude the possibility of even glancing at many points not noticed. The leading principles, however, to be borne in mind by the designer of farm buildings, have been considered, elucidated, and illustrated. When describing the construction and arrangement of the component parts of a STEADING, an opportunity may perhaps offer of illustrating some points which have been here necessarily omitted. As the object of this paper is to explain the *arrangement* of farm buildings, not the *details* of their construction, constructive points, such as rounded corners, coped walls, timber to be used, roofs, etc., as well as the construction and arrangement of the various apartments of farm buildings, will be found under one or other of the several heads as follows: BARN, BYRE or SHIPPON, CALF-HOUSE, CATTLE-SHED, CHEESE-ROOM, COW-HOUSE, DAIRY, FOWL-HOUSE, GRANARY, HAMMEL, HOME-STEAD, LIQUID MANURE TANK, MANURE or DUNG-HOUSE, PIGEON-HOUSE, PIGGERY, POULTRY-HOUSE, SHED, SHEEP-PEN, STABLE, WORKSHOP, etc.

Besides the works by STEPHENS and by EWART above mentioned, others to be consulted are, MORTON, *Cyclopædia of Agriculture*, s. v. Farm Buildings, 8vo., Glasgow, 1855; the Prize Essays on Farm Buildings, given in the *Journal* of the Royal Agricultural Society of England, vol. xi, 1850; ANDREWS, *Rudimentary Treatise on Agricultural Engineering*, 12mo., London, 1852-3; and STEPHENS and BURN, *The Book of Farm Buildings; their arrangement and construction*, now in course of publication.

R. S. B.

As already observed, great and widely differing opinions exist on the proper planning of a farmery. A practice is now obtaining, amongst the Lincolnshire farmers especially, of subdividing the farm-yard so as to classify the cattle in them, as well as to afford them better shelter. Besides the system described from the three woodcuts given in the text, the *Illustrations*, s. v. AGRICULTURAL BUILDINGS, show lately executed examples of others, which are presumed to sufficiently explain themselves without further reference. The plate 1854-55, pt. 2, has two farms erected for practical farming of Lincolnshire and adjoining counties; one from 350 to 500 acres, the other from 400 to 600 acres. Plate 1856-57, pt. 1, exhibits a homestead in Dorsetshire for an arable farm of 700 acres, and for a dairy-farm of 350 acres. Plate 1856-57, pt. 1, illustrates the large farm buildings of Berwickshire, N.B.; and also the

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buildings for a stock-farm in Kent, the owner of which has lately suggested that he would prefer to have the straw barn in the centre, and the engine house and smithy at the north end; also a locomotive, instead of a fixed engine; also a moderate sized homestead in the centre of the farm for housing horses and the most valuable portion of the cattle; and as the carting of manure a long distance is very expensive and tedious, he recommends two or three small barns to be erected at the extremities of the farm, in warm and sheltered situations, with good sized yards round them for housing the cattle in winter, fed on the oat, barley, and bean straw, *threshed by hand*, with a little cake which improves the manure and cattle also: the manure is then at hand to the fields where it is required, and the cattle are fed cheaper and thrive better than they do in more elaborate buildings. Preferring a high situation for the homestead, he does not object to any soil, provided the site is dry and warm: the quality of the water is of the greatest importance, and must have considerable weight in the choice of situation; he has found that water impregnated with sulphate of iron is peculiarly favourable to the health and breeding of animals, though injurious to a certain extent to horses. The great object to be accomplished in erecting farm buildings is simplicity of arrangement, so as to economise labour; it is bad to have too many apartments, as many doors (which ought to slide) are objectionable; and there should not be too many animals under one roof, in case of any contagious disease breaking out. A fourth plate, 186-186., shows the system at present adopted in France. All experience shows the error of forcing animals.

The architectural character or effect to be given to such buildings depends something on the locality of the steading; but it has, and still does, mainly depend upon the pocket of the landlord, who, as a rule, cares nothing whatever about it; and farmers never trouble themselves about it. Where a professional man, however, is employed, he may so use the materials at his command as to obviate the commonly meagre appearance of such erections, without giving the client cause to complain of wasting his money. Probably the most ornamental portion will be the farm-house, a building which, with the labourers' cottages, it is unnecessary herein to treat separately from all other dwellings of such descriptions; excepting that the former should be especially arranged so as to command the farm-yard, that the operations may be always under the eye of the farmer.

Besides the works named above may be mentioned VERELST, *Remarks on Farm Buildings*, printed in the *Liverpool Mercury*, Nov. 1856, and partly reprinted in the *BUILDER Journal*, 1856, xiv, 701; *The Arrangement, etc., of Farm Buildings*, in the *BUILDING NEWS Journal* for 1860, commencing at page 311; *Remarks in BUILDER Journal*, 1851, ix, 555, giving details of that at Wark; a plan of that at Coleshill, Berkshire, xii, 653; and of that near Bristol, xiii, 340, 367: the *DUBLIN BUILDER Journal*, 1859, i, 143; the *ILLUSTRATED LONDON NEWS* gives a model farm in Berkshire, 1846, ix, 27; one at Liscard, Cheshire, 1849, xv, 389; and that at Shirburn, Oxon, 1857, xxxi, 585; RHAM, *Dict. of the Farm*, revised edit., 8vo., 1853; DEAN, *Construction of Farm Buildings*, 4to. 1849; STARFORTH, *The Architecture of the Farm*, 4to., 1853; DONALDSON, *Improved Farm Buildings*, 4to., 1851; and *On Farms and Cottages*, 4to., 1854; ANDREWS, *Construction of Agricultural Buildings*, 8vo., 1852; LONDON, *Encyclopedia of Cottage, Farm, and Villa Architecture*, 8vo., 1842, 999, 1024, 1155; the volumes, published by MEECH on his operations in Essex; and the *Encyclopædias* generally.

The following publications illustrate farms elsewhere than in England; *ENCYCLOPÉDIE D'ARCHITECTURE*; *MONITEUR DES ARCHITECTES*, 1851, vi; *BAUZEITUNG Journal*, pl. 557, ser. 1; *LA PROPRIÉTÉ*, pl. 1 and 21, ser. 2; *NOUVELLES ANNALES DE LA CONSTRUCTION*, fol., Paris, 1858, iv, 36; NORMAND, *Paris Moderne*, 4to., Paris, 1850, vol. iii, *passim*.

The American farms, etc., are described by ALLEN, *Rural Architecture*, 8vo., New York, 1854, given in *BUILDING NEWS Journal*, 1855, p. 761; and by DOWNING, *Country-houses*, 8vo., New York, 1852.

FARTURA or FRACTURA. A Latin term literally meaning 'cramming', equivalent to the mass of rubble heaving used to fill up the body of a wall between the outside surfaces when the wall was not constructed of solid masonry or brickwork; thus VITRUVIUS, ii, 8, has "tres—crustæ duæ frontium et una media farturæ;" and, in the same chapter, he says, "in medio faciunt partis separatim cum materia cæmentis;" and PLINY, *Ep.*, x, 48, complains of "parietes—sine cæmento facti."

FASCES. In decoration, a number of rods cut from the birch or elm, and bound round with thongs. As an emblem of authority, it is represented as having an axe tied up with the rods; but as this was not allowed to the magistrates (except a dictator) in Rome, after the consulate of Publicola, the axe should be omitted when the authority is not that of an officer in supreme command, or of a judge in criminal cases. When used in connexion with tokens of victory, either a branch of laurel was inserted into the top of the rods, or a laurel wreath was hung on the side of the fasces: and on occasions of mourning the fasces were reversed, or even broken.

FASCIA. A long narrow strip of cloth. The term used by VITRUVIUS, iii, 3, for each of the three divisions or faces termed respectively, first, second, and third, beginning with the lowest, which he directs to be made in the architrave of the Ionic Order, under its cymatium. The word has been received in this sense into the English language, but the use of it has been extended to bands or string courses, as in *LANGLEY, London Prices*, 12mo., London, 1750, p. 291, pl. 25.

FASSI (GUIDO), also called Guido del Conte, son of Francesco Fassi, born at Carpi, was baptized 2 December 1584. The campanile of the old collegiata being wanted at the site of the new church, he proposed to remove it bodily, but the necessity of removing part of the ducal castello caused the tower to remain undisturbed. Fassi, however, proved his capacity for the work by moving a large pigeon-house erected on four tall pillars at La Tintoria, near Carpi. In his native city he commenced, 1615, the large public granary and bakehouse, and 1621 the church of S. Giambattista. The earliest work in scagliola, dated 15 June 1615, was the work of Fassi, whose claims to the invention are acknowledged, and whose chief works therein are mentioned by Tiraboschi, *Notizie*, 4to., Modena, 1786, p. 184, citing MAGGI, *Memorie*, p. 186.

FASTIGIUM (and FASTIGIATUS, properly FASTIGATUS) its derivatives. Latin words of unknown origin, but as in a peculiar sense they seem to have been used in connexion with temples, as will be stated hereafter, it may be conceived that they have some affinity with the sacred word *fastus*. Four meanings will have to be considered.

1. The slope or fall of any surface or plane (*libramentum*). Thus VITRUVIUS, ii, 1, speaking of the primitive habitations or huts, describes men as merely heaping reeds and branches upon them (*arundinibus et fronde*) to avoid the heat; but as these would not keep out the winter rains, then making the covering sloping (*fastigia facientes*) and with eaves to throw off the drip. The same author, viii, 7, speaking of aqueducts, says they "should have (*libramenta fastigata*) a fall (or more literally a hanging level) of not less than half a foot in a hundred feet (PLINY, xxxi, 31, says only a quarter of an inch) to convey the water." VITRUVIUS, vii, 1, where he treats of the pavement called *ruderalio*, directs the pavement to have a fall (*fastigium*) of two fingers (*digitos binos*) in ten feet. And in the chapter on building in damp situations, vii, 4, speaking of the floor of a triclinium in such a spot, he directs the ground to be dug out, and a rough pavement to be rammed in, with such a fall (*ita fastigatum*) that it may be readily drained.

CÆSAR, *De Bello Gallico*, iv. 17, describing the famous

bridge over the Rhine, says he drove the strutting piles, "not perpendicularly, but inclined and sloping, *non ad perpendicularum sed prona ac fastigiata*." In the same work, viii, 14, he uses the phrase *declivi fastigio* to signify sloping ground; and *De Bello Civili*, i, 45, he says '*declivis locus tenui fastigio*'. So it would appear there is abundant proof that the primitive meaning of fastigium is a slope.

In a figurative sense it means the same thing. Cornelius Nepos, in the *Life of Atticus*, xiv, says "*parique fastigio steterit in utraque fortuna*", he held his head equally high whatever his fortune.

2. Another meaning of the word fastigium is the gable end or pediment of a temple, probably because it is formed of two slopes. This the Greeks called *ἀέτωμα*, from its resemblance to a flying eagle with outspread wings. Any one who has seen them swooping down from the tops of the Apennines on to the wild Campagna, at early dawn, must have been struck with the resemblance. HENRY STEPHENS, *sub voce*, refers to EUSTATHIUS, and to a commentary on HIPPOCRATES, as his authorities. The Roman roofs were, no doubt, not gabled but always hipped as they are at present in Rome, and were at Pompeii. The gable or pediment was the mark of the temple, CICERO, *De Orat.*, iii, 46. Thus FLORUS, iv, 2; CICERO, *Phil.*, ii, 43; and PLUTARCH, *Vit. Cæsar*, state that when the senate decreed divine honours to Julius Cæsar, they not only appointed a flamen or priest, and erected an image, but added a fastigium to the roof of the house. "*Fastigium in domo*" are the words of FLORUS. These were sometimes open, as is learnt from JUSTIN, xxiv, 8, in his account of the attack of the Gauls on the temple at Delphi, when the God is said to have been seen descending from heaven and entering the temple through the open gable of the roof—"per culminis aperta fastigia." They probably were left open to allow of the escape of the smoke of the sacrifices. VITRUVIUS, iii, 3, has '*tympanum in fastigio*'.

3. In a more limited sense, the fastigium seems to mean that part of the corona, and the cymæ only, which are above the tympanum of the pediment. Thus VITRUVIUS, iii, 3, speaking of the parts of the entablature of an order, enumerates the architrave, frieze, corona, tympanum, fastigium, and acroterium; and in iv, 2, says, "the ancients did not approve, nor did they order, mutules or dentils to be made in the fastigium, but plain (*puras*) coronæ." In the first of these instances, the fastigium is considered as much a separate part of the order as the frieze or architrave. In the second it is clearly also considered as distinct, for in the parts of the coronæ which are *under* the tympanum the mutules always were placed. LIVY, xxxv, 10, speaks of golden shields, purchased with the produce of some fines, as being placed "*in fastigio ædis Jovis*." Of course, by this he means, as he always does, the temple of Jupiter Capitolinus. They could hardly be placed in the tympanum, as it was occupied by the celebrated terra cotta statues. He probably, therefore, refers to the trophy of arms on the acroterium; and he uses the term in apparently the same sense, xl, 2, '*fastigia—a culminibus abrupta*'.

4. From these meanings fastigium is frequently used for the extremity or top of anything. CICERO, *De Off.*, iii, 7, applies it to the top of a building in opposition to the foundation. The word also, as in VITRUVIUS, iv, 2, means sometimes the crest of anything. SERVIUS, commenting upon VIRGIL, *Georg.*, ii, 288, says that the word fastigium means not only the top of a ditch, but the bottom, and that it is used in the same sense as *altum*, which means not only the depth of the sea, but the height of the heavens. MURATORI, *Inscr.*, iii, 618, suggests that fastigium meant merely a canopy supported by four columns to a shrine or a statue.

A. A. FATHOM. An English measure of length, usually containing six feet; though five feet six inches, and five feet, have been called fathoms in different localities.

13. FAUCES. The Latin term for the gullet, which was ap-

plied metaphorically by the Romans to a narrow entrance or confined pass, whether natural or artificial; as well as by CICERO, *De Divin.*, i, 48, to the starting-place for chariot-races; and as regards buildings, to a passage, more particularly to that lobby G in the illustration s. v. ATRIUM, which gave access without going through the tablinum, from the atrium, to the peristyle. VITRUVIUS, vi, 4, prescribes the width of each such lobby as from a half to a third of the width of the tablinum, after the size of that apartment had been determined from that of the atrium according to his rule. As to these passages it is usually stated that "as there were frequently two of them, one on each side of the above apartment, the word is commonly used in the plural," and to this effect VITRUVIUS is cited: whereas that writer, like almost all classic writers, does not seem to have known the word in the singular.

FAVARIIS (JACOBUS DE) is mentioned as the successor to Henry of Narbonne during the erection of the cathedral at Gerona in Spain, in a register entitled *Curia del vicariato de Gerona, liber notularum, ab anno 1320 ad 1322*, fo. 48, according to VIOLETT LE DUC, *Dict. s. v. Architecte*, p. 112, who has not indicated the precise source of his information, which does not seem to have been known to CÉAN-BERNUDEZ. He states that this Jacobus, who undertook to go from Narbonne to Gerona six times in the year, was paid a salary of two hundred and fifty sous each quarter, or about £240 per annum of present English money; and considers this to be a very early instance of an architect who was neither builder nor clerk of the works, but furnished the necessary instructions, and watched from time to time the execution of them.

FAVENTIA. The Roman name of FAENZA in the Papal States in Italy.

FAVISSA. A cellar or pit constructed beneath a temple to receive such images, furniture, ornaments, or implements, belonging to the structure as became unfit for use, and which being sacred could not be removed from the temple; according to VARRO, *ap. Gell.*, ii, 10. FESTUS, s. v., states that the small pits to hold water for the use of the temple were also so called. RICH., *Illust. Comp.*, 8vo., London, 1849, s. v., notices that three pits of this nature were discovered under the ruins of a temple at Fiesole filled with damaged and mutilated statues, vases, lamps, utensils, and musical instruments.

FAVRE (TITUS), a Walloon by birth, obtained the title of *Oberlandbaumeister* at Berlin, where he succeeded after Gerlach's death, 1737, in obtaining considerable employment, although, according to NICOLAI, *Beschreibung von Berlin*, 3rd edit., 8vo., Berlin, 1786, he could not make for himself the necessary drawings or calculations. His first commission was to restore the tower of the church of S. Peter, for which he procured a model from a cabinet-maker; and he subsequently made use of the talents of other artists in Berlin, to whose designs his name was attached, as in the case of the Trinity Church, really due to the *obermaurermeister* Naumann. He was superseded on the accession of Frederic II, 1740, and died 1745. 68.

FAWN COLOUR is made by a mixture of white, yellow ochre, and Spanish brown.

FAY. A village near Lyon in France, which furnishes from its quarries a calcareous stone called the *choin antique*, that resembles white marble, and which seems to have been used by the Romans in their works at that city. BRARD, *Minéralogie*, 8vo., Paris, 1821, ii, 15.

FAYD'HERBE (LUC), born 20 January 1617, at Malines, built at Louvain the church of S. Michel; at Malines the church of S. Pierre, and that of Notre Dame d'Hauswyk or d'Ansewyck, 1663-72 or -78; and the church, 1664-70 or -72, of the abbey at Everbode, to which IMMERZEEL adds the church of the priory at Leliendaal. He died 31 December 1697 (IMMERZEEL says 1694), at Malines, and was buried in the cathedral there. COMMISSION ROYALE D'HISTOIRE, *Recueil de Bulletins*, 8vo., Brussels, 1848, xiv, 75. Jean van Delen was one of his pupils.

FAYOUM, in Egypt, see MEDINET EL FAIOM.

FEATHERED FILLET. A fillet of wood having a triangular section. **TILTING FILLET.**

FEATHER EDGE BOARD. A board thicker at one edge than another. It is generally used for covering the sides and roofs of barns, sheds, etc., being nailed each overlapping the other a little, so as to exclude the air and throw off the rain.

A. A.

FEATHER-EDGE COPING. A coping cut out of blocks of stone with one edge thicker than the other, and generally set on the front parapets of houses, the thickest edge being placed towards the street. It is, of course, more economical than parallel coping of the same front thickness, and also carries off the water more readily into the gutter. It should, however, project sufficiently over both sides of the wall, and be properly throated at both edges.

A. A.

FEATHER-EDGED BOARD. A board having a tapering form towards the edge.

FEATHER FILLET. A fillet of wood cut obliquely with the grain and glued behind a dado or other joint to prevent its flying. **FEATHER TONGUEING.**

A. A.

FEATHERING. The name applied to each foil or lobe confined by the cusps in mediæval tracery; although RICKMAN, *Attempt*, 8vo., 1819, speaks of "small arches and points which are called featherings or foliations, and the small arches cusps; the cusps are sometimes again feathered, and this is called double feathering"; whereas he should have said, that when each main foil or lobe is again divided by cusps into smaller lobes the work is said to be double-feathered. It has been suggested, that as 'foliated' implies the curves and cusping, feathered should be restricted to cases in which the end of the cusp is ornamented.

FEATHERING. A term explained in the following observation by BUCHANAN, *Millwork*, 3rd edit., 8vo., London, 1841, p. 352: "The advantage is evident of making cast-iron in thin broad plates, at right angles to one another, instead of imitating the solid forms of wooden framing. This practice is called by millwrights *feathering*. This refers to **L** and **T** cast iron.

FEATHER TONGUEING. The best method of joining the edges of boards together. A ploughed groove is formed in the edge of each, and the tongue which goes into them is cut obliquely out of a board and not with the grain, so that it neither swells in width nor opens the joint.

A. A.

FEATHER WEDGING, see FOX-TAIL WEDGING.

FECIT, see EXTRUXIT.

FE DE ANTIOQUIA (SANTA). A city in the republic of New Granada in South America. It is tolerably well built, and has a cathedral dedicated to the Conception of the Virgin, several monasteries and convents, and a college.

FE DE BOGOTA (SANTA). The capital, founded 1558, of the republic of New Granada in South America. In consideration of earthquakes the houses are rarely two-storied, and are generally built of clay beaten into moulds (*pisé*), with quoins of sun-dried bricks; the roofs, which are tiled, show no chimneys, as stoves only are used; the streets have a central stream of water and no sewers. A fountain decorates each of the four squares. The old palaces of the governor and of the 'udienza'; the archiepiscopal palace; the cathedral dedicated 1814, to the Conception of the Virgin; the government-house, 1825; the hall of congress; the old college of the Jesuits; the noviciate and monastery of 'good brothers', or religiosi di S. Giovanni di Dio; the Dominican monastery; about thirty churches belonging, all but three, to monastic establishments; the theatre; and the mint, are almost the only edifices built of stone. The three hospitals, founding, civil and military, are on a large scale; the public library, observatory, university with three colleges, academy, botanic garden, and cemetery, have been in a declining state from the middle of the last century.

FEDELI (FRANCESCO), born at Como, erected 1479-82 the church of Fonte-Giusta at Siena.

FEDERZONI (ANDREA), son of Bartolommeo of Carpi, was architect to Alberto Pio, lord of that city, for whom he designed about 1511 the church of Sta. Maria della Rosa of the Minori Conventuali, now destroyed, on the plan of the Pantheon; the fortifications dating 1518; and the church of Sta. Maria delle Grazie of the Servites, 1523, which was discontinued by the misfortunes of that prince. He was also employed by the same patron to continue the church of S. Niccolò of the Minori Osservanti, commenced 1506, recommenced 1516, and completed some years later. Federzoni's name does not occur after 1523, but to him was entrusted the execution of the duomo from the designs and model furnished by B. Peruzzi: the works, interrupted as before mentioned, were resumed 1606, and from its documents, a Jacopo, son of Antonio Federzoni, appears to have been engaged 1665 on it as architect. *TIRABOSCHI, Notizie*, 4to., Modena, 1786, p. 201.

FEDRIGHINO (BERNARDINO), son of Matteo, was born 2 January 1646 at Predore; studied at Brescia under Bart. Spazzo and Laz. Bracco; and about 1680 settled in that city. The parish churches at Orzano, Pompiano, Nari, and Minerbo in the district of Brescia, and at Villongo in that of Bergamo; the church of SS. Faustino e Giovita in Brescia; and for nearly fifty years the works at the new cathedral in that city, besides a large number of shrines, oratories, and other works for the clergy and laity. He died 22 February 1733, and was buried in the church of S. Clementi. *TASSI, Vite*, 4to., Bergamo, 1793, p. 107.

FEDRO (IL MAESTRO), see BERGAMO.

FEERANDAH, see VERANDAH.

FEINT ARCH. The name used in the Essex MSS., now in the British Museum, Add. MS. 6768, p. 157, for the blank arcading in mediæval architecture.

FELBER (HANS) built 1416 at Augsburg a conduit near the Hauptstätterthor, and made the design for the S. Georgenkirche at Noerdlingen, which place he visited repeatedly 1427-36 to inspect the works executed from his instructions; Conrad Heinkelmann being clerk of the works.

FELBER (HANS), probably the son of the preceding architect, was *baumeister* to the outer church at Waiblingen, completed 1488, with a tower so built that no joints are visible.

FELDE or FIELD. The flat interior part of a casement or sunk panel. *WYCESTRE, Survey of Bristol*, 1480.

FELDMAN (CHRISTIAN FRIEDRICH), born 1706 at Berlin, superintended the erection of the schloss at Rheinsberg from designs by Kemptner, and of the Garrisons-kirche at Berlin from those of Gerlach. He attained 1756 the post of *baurath*, and died 1765 at Berlin, where he had erected many private houses.

FELET, see FILLET.

FELIBIEN, Sieur des Avaux et de Javeroy (ANDRÉ), born in May 1619 at Chartres, was one of the eight original members of the Academy of Architecture founded 1671 at Paris: he published amongst other works not relating to architecture, *Desc. de l'Abbaye de la Troppe*, 12mo., Paris, 1671, 1678, 1682, 1689; *Desc. de la Grotte de Versailles*, 4to., Paris, 1672; *Desc. sommaire du Château de Versailles*, Paris, 1674, Amst., 1703; and *Principes de l'Architecture*, etc., with a *Dictionnaire des Termes*, 4to., Paris, 1676-90; and left a MS. *Histoire des Châteaux Royaux*, preserved in the imperial library at Paris. He died 11 June 1695.

FELIBIEN (JEAN FRANÇOIS), eldest son of the subject of the preceding article, was born about 1658, became 1696 a member of the Academy of Architecture at Paris, and published *Recueil Historique de la vie et des ouvrages des plus Célèbres Architectes*, 4to., Paris, 1687; *Plans et Dessins de deux Maisons de Campagne de Plaine, avec des remarques et une dissertation touchant l'Architecture Antique et Gothique*, 12mo., Paris, 1699, and in Italian at Venice, 8vo., 1755; and *Descr. de la Nouvelle Église des Invalides, avec plans*, 12mo., Paris, 1702, and repeatedly afterwards. He died 23 June 1733.

FELIN (DIDIER DE) is mentioned under the date 20 July 1504 as '*maître des œuvres de maçonnerie de la ville, et maître principal touchant la surintendance de l'ouvrage de la maçonnerie*' of the pont Notre Dame at Paris, agreeing with Fra Giocondo '*commis au contrôle de la pierre*' in recommending that the arches should not be semicircular, because they would make the bridge too high: SAUVAL, *Histoire*, fol., Paris, 1724, i, 230.

FELLING or FALLING. The operation of cutting down growing timber trees, for the purpose of sale or conversion into building scantling. The quality of the timber may be materially affected by the manner in which this operation is performed.

Timber for building purposes must be effectually cleared of the sap, because the fermentation of it is one of the most dangerous causes of decay after the tree has been cut down, superinducing dry rot when the wood is used in confined situations. It is, however, equally important that the escape of the sap should take place regularly throughout the body of the tree, and that the rapidity with which it is withdrawn should not be such as to cause the fibres of the wood to separate, or shrink from one another. On these accounts, therefore, it is advisable to confine the operation of felling to the winter season; because during that period of the year there is less sap in motion than when the trees are in leaf, and because evaporation takes place more gradually than in summer. If it should, under peculiar circumstances, be necessary to fell timber in the hot season, the wood should be stacked on end if possible, and in a cool, shady place, where the sun's rays could not affect it. That it was the custom to fell oak timber in winter, during the mediæval period, is proved by a letter remaining in the records of the cathedral at York, partly given in the *BUILDER Journal*, 1859, xvii, 257. Beech, however, is said to last longer when cut in the summer.

Trees are felled either by being sawn through at the butt, or by being cut away, to a species of wedge shaped end, by the axe. Care must be taken to prevent the tree in falling from striking against any of the growing trees in the forest; the branches and head, technically called 'lop and top', should be cut off before the tree is thrown, lest they should injure other trees or the underwood. It frequently happens, when a tree is felled by the axe, that a portion near the centre is torn away with an irregular fracture, producing what is technically known as a *ground shake* (*un trou d'abattage*), extending perhaps to some distance into the stem: this accident arises mainly from the imperfect manner in which the fibres of the wood have been cut through, and it therefore becomes a matter of importance to prevent the workmen from hauling the ropes fastened to the upper end of the tree, until the butt has been cut through as far as it is possible so to do with safety. Ground shakes do not affect the durability of the timber, but they diminish its powers of resistance to mechanical efforts; and it is therefore also desirable that the felling should not take place during gusty weather.

DUHAMEL, who appears to have entertained doubts with respect to the correctness of the generally received opinions upon the period most favourable for felling timber, states that an advantage is gained by previously cutting through the bark and sap wood of the standing trees, so as to form a wound upon the whole of their circumference through which the sap may escape. From some direct experiments he was also led to the conclusion that the wood of trees, which had been barked when standing, was both denser and of greater strength than the wood of trees barked after being felled; and it certainly would appear that the sap was more rapidly and more effectually withdrawn from the former than from the latter. A trifling increase in the number and in the depth of the star shakes of the outer wood, in consequence of its more rapid desiccation, takes place, however, under these circumstances; and it therefore follows that wood which is intended for ornamental joinery

should be obtained from trees which have been barked after they have been felled. In England the woodmen say there is practically no difference, and pursue whichever method is most convenient.

EVELYN, *Silva*, ed. HUNTER, 4to., Lond., 1825; SELBY, *British Forest Trees*, 8vo., Lond., 1842; DU HAMEL, *De l'Exploitation des Bois*, 4to., Paris, 1764; NANQUETTE, *Exploitation, etc., des Bois*, 8vo., Paris, 1859; NÖRDLINGER, *Die Technischen Eigenschaften der Hölzer*, 8vo., Stuttgart, 1860. G. R. B.

The best method to fall timber is to lay the roots bare by removing the earth, cutting them through, and then dragging the tree down or 'throwing' it by a rope fixed to its top. It is technically called 'falling with a butt.' If the stumps are intended to be left to produce underwood, the tree is generally cut off by the cross-cut saw about a foot from the ground, and the roots left undisturbed. Clusters of small shoots will then spring out, which are cut off when they arrive at proper size for poles, stakes, faggots, etc. Such stumps with their produce are technically called '*stools*'. Small stuff is often cut down with the axe, but it is not a good plan, as the irregularities of the cut hold water, which descends into the stump and rots it. Besides, as the tree mostly comes down before it is quite cut through, the uncut part splinters, and causes 'ground shakes.' Trees should always be felled in winter, as in that case there is no flowing sap in the body of the stem, or in the woodman's phrase 'the sap is down.' The timber then dries quicker and is sooner fit for use. It is also less liable to split or run into shakes, as there is less moisture to dry out: and it is also for the same reason less liable to rot. But the value of oak bark is so great (in cases of small meetings often worth as much as the timber) that this kind of tree is almost always felled in spring, when the presence of sap between the bark and the wood renders it easy to strip the former from the latter. **FLAWING.** Those however who want oak for purposes of joinery are content to sacrifice the bark, and fall the trees in winter. They then quarter the stems, that is they cut them down into four parts, and expose them to the weather for a year or more to season. These quarters are then cut into plank, which is again seasoned another year. A. A.

FELL STONE. A term in use in the district of North Craven, Yorkshire, for the bed of stone, a kind of millstone grit, lying on the limestones of the upper valleys. It is of various degrees of excellence, but usually of a coarse, hard, and what is called "hungry" character. This was the stone invariably used in the churches of the district, and its rough texture mainly accounts for the absolute want of ornamentation. *Reports and Papers of Associated Societies*, etc., 8vo., 1854, 34-5.

FELNIL, near Jemmappes, in Belgium, contains, with Arquesorel and Soignies, quarries of a limestone that is exported to Holland, furnishing columns from 20 to 24 ft. in length, and resisting perfectly water, air, and frost. BRARD, *Minéralogie*, 8vo., Paris, 1821, ii, 22.

FELSPAR. A compound mineral consisting of an aluminous, alkaline, or earthy double silicate, with a base of soda, of potash, of lithium, or of lime, which, in its crystallised form, enters into the composition of granites; and in its amorphous state constitutes the mass of the fine Kaolin clays used in the ceramic arts. DELABECHE, *Geological Observer*, states, that oxide of iron, oxide of manganese, and magnesia, are also frequently present in connexion with the other ingredients mentioned above; and it is no doubt to the presence of these metallic oxides that the various colours of felspar may be attributed. HAÜY states, that the primitive form of felspar is that of an oblique-angled parallelepipedon, whose section, taken perpendicularly to the upper edges, is nearly square; the angles of the surface, taken perpendicularly to the long axis of the crystals, are respectively of 65° and 115°; whilst the angles of the surfaces, parallel to the planes of horizontal cleavage, are respectively 120° and 60°, and the long side is

equal to twice the short one, or the side λ is equal to twice μ .

There are seven subsidiary forms of this crystal; but the form most commonly met with, in the ordinary granites at least, is that of a rhomboidal prism. Four of the faces of these prisms are brilliant, but the others are dull; quartz will scratch the face of felspar, which, in its turn, will scratch marble. The specific gravity of felspar is 2.5. It is fusible into a cloudy kind of glass in the ordinary porcelain kilns, and enters largely into the composition of the material known as Parian ware. SALVETAT, *Leçons de Céramique*, 12mo., Paris, 1857; BROGNIART, *Traité des Art Céramiques*, 8vo., Paris, 1854; EBELMEN, *Recueil*, 8vo., Paris, 1855.

The decomposition of the felspar of the granitic rocks, which exercises so marked an influence upon their durability, is considered by EBELMEN and FOURNET to take place most rapidly when it is acted upon by water containing alkaline carbonates, and less so by water containing carbonic acid, or even by pure water. The silica of the felspar is dissolved and removed in these cases; and the mechanical aggregation of the rock being thus destroyed, the other ingredients are susceptible of being removed by extraneous action, as frost, etc.

G. R. B.

FELT. A material formed by interlacing loose flocks of wool, or animal hair, without spinning or weaving, so that the texture is spongy and absorbent until the spaces between the hairs have been filled in with some substance introduced in a state of solution, or the surface has been closed by means of the fulling mill. Ordinary, or dry hair, felt is used in building operations on account of its capability of deadening sound; and on account of its non-conducting power, in roofs, where a double ceiling cannot be introduced, or around a boiler, hot-water tank, etc., of a warming apparatus; but as the absorbent properties of the crude felt would expose it to take up and retain external moisture, it is customary, when the felt is used under slating, to impregnate it with asphalt, tar, or with some analogous material. When employed in this position on boarding, there is great risk of dry rot; the better plan is to lay the felt on boards and then to batten for the slates over the felt, so as to leave a good space between the felt and the slates for air. Asphalted felt, on account of its lightness and power of resisting the penetration of water, is frequently used for temporary roofs without the addition of a more durable covering; and then effects the saving of half the timber usually required, as it only weighs about 42lbs. to the square of a hundred feet. Inodorous felt is used as a lining to walls and floors, to conceal the effects of damp, and as a lining to iron houses, to equalise the temperature. Felt is manufactured of any required length by 32 ins. wide.

G. R. B.

FELTERN (. . .) was the architect of the Grand Ermitage erected 1775 at S. Petersburg; the façade of twenty-seven windows in length may be traced as the central mass in the plan given by GRANVILLE, *Guide*, 8vo., London, 1835, i, 520, who attributes to him (misprinted Feltem) the Petit Ermitage, which was the work of Lamotte according to SVININ, *Descr.*, 4to., S. Petersburg, 1816, iv, 15; who, ii, 161, calls him Felter, and notices that he also designed the Gothic ruins at Tsarskoselo as a memorial of the war of 1762. It may be supposed that this architect was the Jarry Felton, or Jurry Matwiewitsch (i.e. George, son of Matthew) Felten, Veldten, or Velten, who, from the notices in HOFER, *Nouv. Biog. Gen.*, 8vo., Paris, 1856, and in NAGLER, *Allg. Kunst. Lex.*, 8vo., Munich, 1850, appears to have been an English architect, to have studied in Italy and France, and to have entered the service of the Russian government, under which he was clerk of the works at the winter palace designed by Rastrelli, professor in the Academy of Fine Arts, and court councillor, 1764, and the favourite architect to Catherine II. The churches of S. Catherine and S. Anne, and the Armenian church in S. Petersburg, were perhaps his best works. He also made the design on a Gothic

style from which the villa at Tschesme was built, 1770; and besides the erection of the three storied wing of the Ermitage, he was engaged upon the Lombard, and several other considerable edifices, inclusive of the completion of the façade to the Academy of Fine Arts designed by Kakorinof, and the great stairs to it. He became councillor of state, and director of that academy.

NAGLER adds that Felton had been engaged upon a large number of plans and models for works that were not executed, such as for a cascade at Tsarkoselo, and for churches at Marienhof and Paulowsky: and that his remarkable machine for the removal of the block of granite for the pedestal of the statue of Peter the Great, was engraved by Schley, who also published several views of S. Petersburg from drawings by Felton, who died 1801 in that city. The machine for the transportation of the granite is illustrated also in CARBURI, *Monument, etc., de Pierre le Grand*, fol., Paris, 1777, who assumes the whole credit of the operation.

FELT GRAIN, see GRAIN.

FELTRE. A city situated in the province of Belluno in Northern Italy. It is well built, having walls but not fortified, and wide well paved streets. The three-ailed cathedral, dedicated to S. Pietro, was rebuilt 1619; the neighbouring episcopal palace; three monasteries and four nunneries, of which the church of Sta. Caterina is the most remarkable portion; two hospitals; the palazzo pubblico; a casa di carità; a theatre; and a few handsome houses, are the chief buildings. 96.

FEMERALL, FEMERELL, FUMMEREL, FUMMERELLE, or FYMRELL (in late Latin *fumarium*). An old term for the lantern placed for ventilation or for the escape of smoke in a roof. It occurs under the date 1531 in the records of expenses upon the hall at Hampton Court: thus 'the kynges bestes to stand upon the newe batilments—and upon the femerell;—three pendants hanging upon the femerall;—a rose crowned standyng on the crowne vovght of the femerall of the hall', are all named in FELIX SUMMERLY, *Handbook for Hampton Court*, 12mo., London, 1859, 64-5, 68. Other instances of the use of this term are given in the GLOSSARY, s. v.

FEMUR. A Latin term used by VITRUVIUS, iv, 3, for the division between each channel of a triglyph. 2. 23.

FENCE. The technical, or rather legal, name for a ditch, bank, hedge, paling, wall, or other enclosure round fields, woods, gardens, etc.

The Roman fences appear to have been of two kinds besides the ditch with its bank (*sepimentum militare*) and the quickset hedge (*viva sepi*), viz. 1, those of wood (*sepimentum agreste*) either made of upright stakes (*pali*) interlaced with brushwood (*virgultis implicatis*) or having rails (*amites longurii*) passing through holes in the posts like what are now called flakes; and 2, those of *pisé* or cobwalls, common in Africa, Spain, and Tarentum; of sun-dried bricks; of baked bricks; and of stone (*maceria*), all which were comprehended in the term *sepimentum fabrile*.

Fences are still formed, as by the ancients, of a hedge with or without a bank, and with a ditch either on one or on both sides of it; of a high bank of earth faced with sods; of the open pales fence having the pales cut to a point, as is in general use throughout Great Britain and Ireland; of rough stone walls without mortar, as in the mountainous parts of Scotland and Ireland; or of unworked flat slabs of stone set up on edge, as common in Lancashire: fences to confine deer or game are sometimes brick or stone walls; but commonly the ordinary park paling is used with an uneven top. **PALING; POST AND RAIL.**

In preparing park fences it is not unusual to speak of deer fences and fox fences, etc. A deer fence should not be less than 6 ft. 6 ins. high if fallow-deer are to be confined, nor less than 7 ft. 6 ins. high to keep red-deer within bounds; they are best when made sloping inward to the park from the outside of a ditch; the height will then not appear excessive to persons out-

side the park. A fox fence requires to have a subsidiary paling projecting about 3 ft. and hanging like a pent-house roof from the main fence. Walls erected as fences to orchards, etc., were 12 ft. high, but of late years there have been few erected of that dimension.*

A *sunk fence* is made by a deep ditch with a fence at the bottom; and a *ha-ha fence* by a wall built against the upright face of a deep ditch, with a light fence placed obliquely outwards near the top of it; both fences being usual as a boundary to a lawn or pleasure garden when required not to obstruct the view. A variety of light fences of iron are manufactured, the most recent being made of wire rope supported at distances of about seven yards by iron standards, through which two or more such wires pass, and fastened at considerable distances to other standards, which are made with spurs to stand the strain of the ropes. The appearance of a long hurdle composed of iron uprights carrying iron wires (the *invisible fence* of late years) is generally unsightly, as the wires either sag in warm weather or pull the standards together in the winter. These defects have sometimes been avoided by the use of light iron rods passing through wood or iron posts fixed at such distances as the rods would bear their own weight.

Duck and fowl fences are best made of stout iron wire, about 2 ft. 9 ins. or 3 ft. high, having along the centre a range of very close wires curling over about 4 ins. to prevent rats, etc., climbing over into the yard.

The ornamental fences made of unbarked hazel or other branches of trees, shown in KRAFFT, *Les plus beaux Jardins*, fol., Paris, 1809, and in PAPWORTH, *Hints on Ornamental Gardening*, 4to., London, 1825, seem to have originated in France towards the end of the eighteenth century. BRARD, *Minéralogie*, 8vo., Paris, 1821, ii, 65, urges the propriety, in localities which possess laminated limestone or schistose rocks, of using such material as dry walling, either laid horizontally, or set upright like palisades in the ground as in the Alps and in Galicia in Spain, where these last fences range from 3 ft. to 4 ft. in height, and from 2 ins. to 3 ins. in thickness, like those above mentioned. BOULDER WALL. 14. 41.

In this article it is unnecessary to notice the ditch as in use in modern times, further than that the surveyor always holds, unless the contrary be shown, that a ditch between two properties belongs in moieties to each: that the ditch of a bank belongs to the bank; and that where there are ditches on both sides of the hedge, or where there is no ditch at all, the proprietorship of the hedge must be proved by acts of ownership; if both parties have equally exercised acts of ownership, the right of the property is presumed to be common; GIBBONS, *Dilapidations and Nuisances*, 8vo., London, 1849, p. 263. Where a boarded, or post and rail, fence occurs, coupled with a hedge and ditch, the boundary of the property may be ascertained by observing from which side the nails are driven, it being generally understood that the nails are driven home-wards; if driven on the ditch side, the brow of it will be the boundary, and if on the other side the wood fence itself. In lanes and parish roads it is very common for the ditch to be on the field side, and the bank and hedge towards the road, without any ditch on the road side; while sometimes a ditch may be observed on both sides: in the former of these cases, the foot of the bank is usually considered the boundary: in the latter case, where there is a ditch on both sides, the road side ditch is taken as the boundary, the other being made for the purposes of drainage. In parts of the country where much woodland exists, a brow or narrow strip of underwood is a common boundary, without ditch, bank, or hedge, to define the precise line of demarcation: in such cases the oldest stubs in the brow, or any timber trees or pollards, may be taken as the boundary; or if there be none of these, the centre of the brow itself. BRUFF, *Engineering Field Work*, 2nd ed. 8vo., London, 1840, p. 35, 36. The width allowed for ditches, measuring from the centre of the quicks, or the brow of the bank, varies consider-

ably in England, according to the custom of the county. Various agricultural fences are illustrated s. v. *Fence*, in MORTON, *Cyclopædia of Agriculture*, 8vo., Glasgow, 1855. A. H. M.

FENDER PILE. A pile fixed in front of a wharf, of a dock wall, or of a coffer dam, to protect the exposed surfaces from injury by vessels, ice, etc. Fender piles need not be carried much below the maximum depth of the line of greatest width of the vessels laid alongside the wharf at the lowest tide; and as a general rule they do not require to be carried more than 10 ft. below the lowest water line. Their dimensions must be regulated by the size of the vessels working against them; but, as their volume is an element of their efficacy, they are usually made of large timbers. PILING. G. R. B.

FENESTELLA (It. *fenestrella* or *finestrella*). A small aperture made in altars and confessions in order to allow their contents to be visible at certain times, and cloths to be laid on the relics. This opening has also been called *cataracta* and *foramen*. Above the relics are usually two such apertures, one outside open to every one, and a corresponding one inside which is opened only by particular favour. This word has also been used for the aperture in a gable for a bell. NICHE; PISCINA. 96.

FENESTRAL. A term employed in HORMANUS, *Vulgaria*, 4to., London, 1519, 242-4, in the passage 'Glasiendowis let in the lyght, and kepe out the winde; paper or lyn clothe straked across with losyngz make *fenestrals* instede of glasiendowis.'

FENESTRATION (Ger. *fenster-architektur*). This term, properly meaning the application of windows to a building, has been adopted of late years for the system of making a design depend upon the effect of windows without columns or pilasters, or rather without an order, because sometimes such windows are decorated with columns or pilasters as dressings. CIVIL ENGINEER *Journal*, 1846, ix, 270, 293, 329; and BUILDING NEWS *Journal*, 1859, v, 1136. 23.

FENEULLE (. . .) designed the casa Venturi, afterwards Pettorelli, at Parma; and 1782 brought into its present condition the ospedale grande or della Misericordia in that city, where he attained the rank of controllore delle reali fabbriche. He died 1798, and was buried in the church called the Trinità Vecchia: DONATI, *Descr.*, 12mo., Parma, 1824, pp. 95, 117, 180, who seems to call him both Augusto and Luigi.

FENGITE, properly PHENGITE, MARBLE.

FENYAILLE. An old mode of writing FINIAL. 16.

FERABOSCO, see FERRABOSCO.

FERENTI, FERENTINO, or FERENTO, the Etruscan and Roman Ferentinum or Ferentum. A city, near Viterbo in the Papal States, which was destroyed 1171-2 (SARZANA, *Della Capitale de' Tuscaniensi*, 4to., Montefiascone, 1783, p. 144), but which still presents, amongst the foundations of mediæval structures, vestiges of Etruscan and Roman work, with some well-sepulchres, and a theatre having a stage front 186 ft. long, described by DENNIS, *Cities*, etc., 8vo., London, 1848, i, 205, and illustrated by CANINA, *Ant. Etr. Maritt.*, fol., Rome, 1846, pl. 118; this theatre is remarkable especially for six lintels (a seventh has lately fallen) formed of flat arches. 96.

FERENTINO. A city in the legation of Frosinone in the Papal States. The cathedral, dedicated to SS. Giovanni e Paolo, is partly ancient, partly modern; the chief other buildings are the large Gothic college of Sta. Maria Maggiore; five modern parish churches; a Jesuit college; the monastery of Sta. Agata belonging to the Minori Osservanti; two nunneries; and a good episcopal palace situate near the cathedral, upon a portion of the ancient walls which, with three gates, have been delineated by DODWELL, *Cyclopiæ Remains*, fol., London, 1834, pl. 97-101. The city still retains the inscription framed by rock-cut pilasters carrying a pediment, recording the bounty of Quinctilius Priscus. 96.

FERGUS (JOHN) erected the royal exchange at Edinburgh, the contract for which was signed June 12, 1754: it was com-

pleted 1761, at a cost of £31,000. The plan, elevation, and detail contract, which is interesting from its date, are given in the *SCOTS MAGAZINE*, 1754, xvi, 415.

FERIBY or FERYBY (JOHANNIS DE) was contrarotulator of the payments made for the coronation of king Edward III, 1 February 1327; and in the third year he was appointed clerk of the works at the palace of Westminster and Tower of London for life: *Rot. Orig. Abbrev.*, p. 31, Rot. 16, as given in BRAYLEY and BRITTON, *Palace of Westminster*, 8vo., London, 1836, 141, 143, 244.

FERME ORNÉE. A term applied to the ornamented property of an amateur farmer. Thus 'Mr. Southcott, at Woburn farm, in Surrey, first introduced that union of utility and beauty, denominated the *ferme ornée*,' NEALE, *Views*, 4to., London, 1818, i, pref. 19: and Whiteknights, near Reading, Berkshire, the seat of Sir Henry Englefield, bart., 'was one of the first examples of the *ferme ornée*,' according to the description in GROSE, *Ant. Rep.*, 4to., London, 1808, iii, 255.

FERMO. The capital of the legation of the same name in the Papal States. The town, standing on a hill, is surrounded by walls and ditches constructed 1446: the great piazza was enlarged and decorated about 1425-75 with a double lateral portico, and contains several handsome buildings, viz. the palazzo municipale dating 1308, finished about 1490-1510; the archiepiscopal palace, completed 1391; the palazzo governativo, 1502-32, enlarged and raised one story 1816; the university, with a front so much altered by restoration as to be assigned to Fontana, 1585-92; and the teatro dell'Aquila, designed in the last century by Cosimo Morelli, one of the largest and finest works of its class in Italy. The cathedral, called also Sta. Maria in Castello, placed at the summit of the hill, was rebuilt after the fire 21 September 1176 from the designs of Giorgio da Como, called di Jesi, and was finished 1227, but this building appears to have been enlarged just before its high altar was consecrated 1351; the old façade and campanile were cased with marble about the beginning of the last century, at the close of which the three-ailed interior was modernized, if not rebuilt, by C. Morelli. Amongst the other churches should be noticed those of S. Francesco, erected in a Pointed style during the thirteenth century; S. Domenico; S. Agostino; S. Rocco, built 1503; and S. Michele, 1632. Some large and handsome palazzi, the ospedale degli infermi, the founding hospitals, and two or three educational establishments, deserve some notice. FRACASSETTI, *Notizie Storiche*, Fermo, 1841, notices the vestiges of Roman art; and DE' MINICIS, *Eleitta*, Rome, 1841, illustrates the castle destroyed 1446, and cathedral, with the piazza maggiore and its edifices. 28. 50. 96.

FERN (Lat. *filiz*). The English name for a genus of plants of which some species employed as models for decoration, and others capable of such application, are given in MOORE, *Nature-printed British Ferns*, 8vo., London, 1860; in LOWE, *Natural History of Ferns, British and Exotic*, 8vo., 1860; and in LANKESTER, *Account of British Ferns*, 8vo., 1860.

FERNACH (JOHANNES PETRUS) of Freiburg, is called Joannes or Annes or Annex de Fernach de Furimberg (Freiburg) Teutonicus, by GIULINI, *Memorie*, 4to., Milan, 1760-74, xi, 444, who mentions him as engaged on the cathedral at Milan some time before 12 March 1391, when he was directed to present in writing the doubts that he had verbally expressed as to the right progress of the structure. He appears to have been sent into Germany with a commission to bring to Milan some other architect, and to have returned without any such companion, before 28 February 1392. It is supposed that, like many other foreign artists, he left Milan in disgust at the treatment he had received; but GIULINI notices that his design for the sacristy of the cathedral was approved and ordered for execution 5 August 1393, but that it was stripped of its ornament, as being too expensive, by Jacopo da Campione and Giovannino de' Grassi. This author has two curious and important passages which should be here noticed: he states, pp. 450-1, that

Enrico de Gamondia, advocating 1392 a quadrangular principle of design, was opposed by the Italian architects, who preferred to work upon a triangular system; and, p. 453, he records the opinion expressed soon afterwards, that Gamondia and Fernach upheld a triangular system: the word triangular in the last passage must be a mistake for quadrangular. STIEGLITZ, *Alt-deutsche Baukunst*, 4to., Leipzig, 1820, p. 176, says that Fernach was afterwards employed on the cathedral at Florence, and was indubitably the Pietro di Giovanni of Freiburg who, 1402, was the chief of the workmen on the cathedral at Orvieto; but no authority is adduced by him for these statements, or for including Petrus as part of the name. 68.

FERNANDES or FERNANDEZ. The name of many persons employed on works in Spain and Portugal; amongst these the following may be noticed.

FERNANDES (MATHEOS) was engaged until 1480 on the works at Santarem; was employed at Alcobaça, and 1508 on the royal residence there. He died 3 April 1515, and was interred at the bottom of the inner stairs near the principal door of the church at Batalha, where his portrait is shown at the top of a pilaster in one of the angles of the chapter house. The capella imperfeita there is more probably his work than the design of the whole edifice which has been usually ascribed to him. He was master of the fortifications of the island of Madeira and of Almeida; and he made the designs for the fortress of Salvaterra. A document dated 2 January 1514 gives his yearly salary at three thousand reis.

FERNANDEZ DE IGLESIAS (LORENZO) completed 1662 the *sagrario* of the cathedral; was one of the five architects who reported 1694 on the works of the collegiate church of S. Salvador; and 1704 executed the principal portal of the archiepiscopal palace; all at Seville. 66.

FERNANDEZ DE LIENA (JUAN) as aparejador to A. de Egas, directed 1459 the execution of the façade de los Leones (to one of the transepts) of the cathedral at Toledo. 66.

FERNANDEZ DE MATIENZO (GARCÍ), after the death 1466 of Juan de Colonia, continued the church of the Cartuja at Miraflores, until his death in the plague of 1488; it was completed by Simon de Colonia. 66.

FERNANDEZ DE SALAZAR (LORENZO) succeeded 16 August 1631 to J. M. Theotocopuli, as maestro mayor of the cathedral at Toledo, and directed the continuation of the capilla del Ochavo in that edifice until his death 4 July 1643. 66.

His son, of the same name, was appointed 23 April 1516 his successor on the works at Batalha, where he died 1528. 66. 88.

FERNANDEZ (DON MIGUEL), sent 1747 to Rome at the royal expense, became 1 April 1757 académico de mérito in the royal academy of S. Fernando at Madrid; on his return to Spain *delineador* to F. Sabatini; and 1760 *teniente* (deputy) *de arquitecto mayor* at the new palace: in 1761 he designed the monastery and three-ailed church of the temple of the order of Montesa at Valencia; he became 13 April 1762 *teniente* to the director of the academy; 1764 architect attached to the real casa de Aposento; and 5 July and 11 November 1774 respectively director of architecture and of perspective in the academy: in 1776 he reported on the security (lightening the weight on the cupola) of the *sagrario* to the cathedral at Seville; and made the geometrical drawings of that work which were engraved by Joaquin Ballester. Amongst his other works were the *retablo mayor* in the church of S. Antonio de los Portugueses, and the repairs to the church of the nunnery of N. S. de los Maravillas, both at Madrid, with its *retablo mayor* and tabernacle. He died 4 Sept. 1786 at Talavera de la Reina. 66.

FERNs. An episcopal town, now little better than a mean village, in the county of Wexford in Ireland. The see was united 1835 to those of Ossory and Leighlin. The ruins of an abbey and a castle; the modern and mean cathedral, which is also the parish church; the handsome and commodious episcopal palace erected 1782-7; and a Roman Catholic chapel, are the principal buildings. 14. 50. 96.

FERRABOSCO (. . .) of Lagno in Italy, built 1534 the pompous pleasure house in the royal garden at Prague, which is said to have cost 100,000 florins; SCHALLER, *Beschr. der Stadt Prag*, 8vo., Prague, 1797, i, 456. He is not to be confused with a Martino Ferrabosco, born 1629 at Naples, whose engravings of S. Peter's at Rome and other architectural studies were published 1684 at Naples. Both names are sometimes written Ferabosco.

20. 68.

FERRACINO (BARTOLOMEO), born 1692 (LALANDE, *Voyage*, 12mo., Venice, 1769, viii, 295, says about 1695) at Solagno near Bassano, restored the roof (destroyed 17 August 1756 by a hurricane) of the Salone at Padua; and replaced the bridge (destroyed 1748 by a flood) designed by Palladio over the Brenta near Bassano: his new bridge, destroyed 1813 by the French under Eugene Beauharnais in their retreat from Italy, and rebuilt by Casarotti, is described by MEMMO, *Vita e Macchine di B. Ferracino*, 4to., Venice, 1754. He died 1775, aged 83 according to MILIZIA, *Opere*, 8vo., Bologna, 1827, iv, 486; TICCZZI says 1777, aged 85 years.

FERRARA. The capital of the legation of the same name in the Papal States. A strong wall with a moat eight miles in circuit, encompasses wide and regular streets, that are lined by well built houses. On the west side is a citadel constructed 1605-21, regularly fortified; and in the centre of the town is the moated castle erected 1385-87 by Bartolomeo Ploti of Novara, which is delineated in GALLY KNIGHT, *Eccles. Archit.*, fol., London, 1842, ii, 35, showing the forked battlements. A campanile, commenced 1412 but unfinished, of four stories faced with marble, which had its foundations enlarged and the first story added 1454 by Bartolomeo da Fiorenza, while the second and third floors date 1491-5, the fourth being the work of Aleotti 1559-97, stands to the south-east of the cathedral, which is dedicated to SS. George and Mauzelius, and has an interior of a Doric order with a triple row of stalls and the bishop's throne in the eastern apse, the altar being in the middle of the choir, with an organ on each side: the church was consecrated 1135: the west front has three equal gables, and the design, marked by the small arcades common in the Early Pointed churches of Italy, seems to have returned along the much mutilated south façade as far as appears above the range of shops with which the latter is encumbered; the rest of the structure has been modernized or rebuilt; COSAZZA, *Della Facciata*, Rome, 1838: thus the choir was renewed by Biagio Rossetti 1498, the presbiterio was reformed by F. Mazzarelli 1637, whose design was continued upon one-third of the church 1711, and the remaining two-thirds were completed for consecration 15 September 1728; leaving the dimensions within the walls 373 ft. 6 ins. long and 124 ft. 6 ins. wide; the winter choir is in the old sacristy erected 1431 by Giovanni de' Genari and his son Bartolommeo. The front is given in HOPE, *Hist. Essay*, 8vo., London, 1840, pl. 28; and one column of this façade in D'AGINCOURT, *History*, fol., London, 1847 (Architecture), pl. 68, who has also, pl. 72, fig. 19, given the casa d'Ariosto 1526-8.

The other principal churches are S. Stefano, in a late Pointed style, repaired 1570, having a tower with a solid brick octagonal pyramid or spire; S. Gregorio, in a late Pointed style, with a square long-panelled brick campanile (commenced at least 1092 and in progress 1146) having a similar termination (such spires are one of the peculiarities of the city); SS. Antonio e Nicolo Tolentino, commenced 1257 by Maestro Tigrino and consecrated 26 Feb. 1413, with a seven-sided apse and classic details, but of a Pointed type like the very large church of S. Andrea, which last was reduced to three aisles and reconsecrated 13 March 1338; Sta. Maria del Vado, cruciform in plan with a clearstory but having no windows to the aisles, a 'rich and solemn' edifice; called, like the 'large and rich' church of S. Francesco and the red brick church of S. Girolamo, pseudo-classical by WEBB, *Eccles. Sketches*, 8vo., London, 1848, p. 406; who notices as peculiarities of Ferrara the arcaded west fronts of

the churches, the eaves-molding like a row of shells, and the short plain semicircular light with a broad hood of molded bricks of great richness; a detail will be found in the *Illustrations*, s. v. CORNICE. Of these it may be added that Sta. Maria in Guado (corrupted to Vado), had its transept and tribune rebuilt by Bartolommeo Tristano before 1473, when the rest of this three-aisled church was erected by Biagio Rossetti so near a pool that Gio. Tosi derived great credit from restoring the left side 1830: the church of S. Francesco, also three-aisled, rebuilt 1495, was restored 1559-97; and the *coro* with the tribune date, like the campanile, about 1605. The other churches of any importance, arranged in somewhat chronological order, are S. Vito 1254; S. Antonio Abate or Vecchio 1410; S. Giovanni Battista 1505-8 by Francesco Marighella; Sta. Maria della Consolazione 1516; La Madonnina 1531 by Alberto Schiatti; S. Benedetto, a three-aisled cruciform church 1553 by Giambattista and Alberto Tristani, chiefly noticed on account of its leaning tower 124 ft. high, built 1621-36, but also interesting in the ruins of its monastery, completed 1561, and lately (if not still) a barrack; S. Spirito, commenced 1559-97, but not finished for consecration till 15 February 1656; del Gesù, designed 1570 by Schiatti, but enlarged by Carlo Pasetti and P. Palmieri, while its college, begun 1676 by the padre Paganini, was only erected in the course of a century; S. Cristoforo with its founding hospital 1570, S. Paolo 1575, Sta. Francesca, completed 1622, and all three by Schiatti; delle Stimate 1621; S. Aurelio de' Capuccini, consecrated 1622; Sta. Barbara, enlarged and rebuilt 23 March 1611, attributed to G. B. Aleotti, who designed S. Carlo 1623; Sta. Maria della Rosa 1624, by Francesco Guitti; the church of the Theatines 1629-53, with the façade and campanile incomplete; Sta. Maria de' Servi 1635, incomplete; the church 1642 of the Capucine monastery of Sta. Chiara, all three by Danesi; Sta. Apollonia de' Francescani, commenced 1662—16 March 1692 by Francesco Muzzarelli; del Corpus Domini 1665, by A. Foschini; S. Giuseppe, consecrated 1671; S. Aurelio or the Chiesa Nuova, used as a theatre, burnt, and reconsecrated 1693; Sta. Giustina, modernized 1709 by Fanani, its single chapel being by Aleotti; S. Girolamo, about 1712, by M. Panizza; SS. Cosmo e Damiano 1710-38, by the two Santini from the design of F. Mazzarelli; S. Domenico, rebuilt 1717 by Vincenzo Santini; and S. Matteo 1758, by the two Santini. The oratories of the Carmelite nunnery of Sta. Teresa were the work of Giuseppe Barbieri; and the oratorio Ferretti 1793 was designed by A. Foschini, who began 1795 the theatre, one of the largest and finest in Italy, but had not completed it 1798, when he was ordered by the French authorities to put on the roof without waiting till the walls had attained their intended height.

Amongst the other public buildings are the palazzo della municipalità; the palazzo della Ragione, built 1326, almost rebuilt 1514, with the external arcades rebuilt 1831 by G. Tosi; the palazzo comunale, rebuilt after a fire 1310, it was partly occupied by two separate theatres, of which one was burnt 1532 and the other 1660; the northern *loggiate* of marble 1560-97 by Galeazzo Alghisi; the torre de' Ribelli, about 1275 by Bonguadagni, it was ruined 1553 and rebuilt 1600; the palazzo erected 1444 for Leonello d'Este, but afterwards the property of the Villafuore, Strozzi, Trotti, who 1553 added the present marble decorations, Bianchini, Libanori, and Costabili, which became 1721 the seminario; la Postaccia 1471-1505 under Gasparo da Corte, for the reception of noble visitors to the court of Este; the palazzo de' Villa, commenced 1493 for Sigismondo d'Este, but modernized 1567, which was also called palazzo di Diamante (a badge of his family) because the façade is of white marble in diamonded chequers, it became 1842 the ateneo civico; the Palazzina, dating 1559; the palazzo del Paradiso, built 1391, became 1567 the university, and was altered 1610 by Aleotti, who added the torretta, the staircase by A. Foschini; the palazzo dell' Arcivescovo was repaired 1717-38 by Tom-

maso Mattei of Rome; the monte di Pietà, commenced 13 September 1756 by Agapito Poggi and Domenico Santini, but not finished till 8 April 1781; and the public granary 1783. The variations of possession give some difficulty in appropriating early notices to the buildings intended; but it would appear that amongst the private edifices of most architectural interest are those called di Schifanoja or della Scandiana 1390, but modernized; Bevilacqua, now Costabili Containi, 1430; Pasino, afterwards Roverelli and now Bentivoglio, 1449; Fiaschi 1476; Costabili, enlarged 1450-71, but in decay; Costabili, now Calcagnini, about 1490; Turco 1499-1555; Avventi 1505-34; Castelli, afterwards Saccati de' Leoni now Prosperi, said to be the design of B. Peruzzi, to whom is sometimes ascribed the portal only, which is attributed also to G. Barozzi da Vignola (the mistake may arise from there being another palazzo Sacrata, now Strozzi); and Gavassini, rebuilt 1738.

While noticing the Passeggio and its arches, one 1705 to the Strada della Giuvella, by Mazzarelli, and another 1786 by Gaetano Genta, mention should be made of the porta Reno, formerly called porta di S. Paolo, attributed to Aleotti, and dated 1612-20. The Campo Santo, established 1811-3 and containing $7\frac{3}{4}$ acres, was formerly the certosa founded 1452-63, and comprises two areas surrounded by an arcaded cloister; the church, built 1498-1551, is attributed to Jacopo Tatti Sansovino, and was restored after the earthquakes of 17 September 1570 and several successive years, which caused great damage to the city. In the suburbs is the church of S. Giorgio, enlarged and repaired when the campanile was built 1485; the façade 1714 is due to Giacomo Bottoni and Francesco Mazzarelli.

BAROTTI, *Pitture*, 1770; FRIZZI, *Memorie*, 4to., 1847-50; and Guida, 1787; GUARINI, *Compendio*, 4to., 1621, with BORSETTI, *Supplemento*, 4to., 1670; SCALABRINI, *Memorie*, 8vo., 1773; CANONICI, *Due Giorni*, 1819; AVVENTI, *Il Servitore*, 8vo., 1838; all published at Ferrara. 14. 28. 50. 96.

FERRARA (GIOVANNI DA), who with Giacomo da Gozzo had designed the ponte delle nave, a stone bridge commenced 1373 at Verona, according to MAFFEI, *Verona*, 4to., Verona, 1731, iii, 137; was summoned from that city to be one of the architects consulted 1 May 1392 upon the questions started by Enrico di Gamondia upon certain works for the cathedral at Milan; the opinions are given in GIULINI, *Memorie*, 4to., Milan, 1760-71, xi, 450-3. The bridge over the Ticino just outside Pavia is also attributed to him by SARAINA, according to BARUFFALDI, *Continuazione delle Memorie Istoriche*, 4to., Ferrara, 1811, p. 97.

FERRARI (ANDREOLO DE'), called Andrea FERRI by TICOZZI, was a Franciscan monk who, with the Dominican Giovanni da Guissano, were the judges appointed to decide 21 March 1401, the disputes between the Lombard and Florentine architects respecting the works of the cathedral at Milan. GIULINI, *Memorie*, 4to., Milan, 1760-71, xi, 458. 27. 62.

FERRARI (DONNINO) is only known from the circumstance that the drawings from which the illustrations of the theatre at Parma, opened 1618, and engraved in RICHARDSON, *Studies*, fol., London, 1848, are inscribed 'Levé et dessiné par Donnino Ferrari'. It was, however, designed by G. ALEOTTI.

FERRARI (FRANCESCO) finished (some authors say rebuilt) 1734 the church of S. Gregorio Magno at Rome, of which (1633) Soria's façade and atrio having been erected, the modernization was commenced about 1700-20; LETAROUILLY, *Rome Moderne*, 4to., Paris, 1840, p. 361. 28.

FERRARONI (GIAMBATISTA) called also il Brighi, was born at Modolena, near Reggio in the Modenese territory, and studied at Rome. He designed the church at Modolena; another at Sesso finished 1711; and in Reggio, besides the church of S. Domenico, and that belonging to the Padri Conventuali; the palazzi Masdoni (afterwards Toschi), and Guicciardi; the logge of the seminario; and the ducal palazzo di Rivalta commenced for Francesco III, when hereditary prince. He died 26 April 1755, aged 93

years and was buried in the church of S. Francesco at Reggio. His son, Domenico, also an architect, died young.

FERREOLUS, or FERREOLUS (SANCTUS), born about 511 at Limoges, became bishop of that city, and rebuilt the church of S. Martin at Brives after the fire that had calcined the columns. He died 595: GALLIA CHRISTIANA, fol., Paris, 1720, ii, 503.

FERRI (ANDREA), see FERRARI (ANDREOLO DE').

FERRI (ANTON) designed the staircase to the palazzo Corsini at Florence. 77.

FERRI, frequently called CIOFFERRI (CIRO), born 1634, finished the high altar commenced by Borromini in the church of S. Giovanni de' Fiorentini; and the cappella Gavotti commenced by Berretini in the church of S. Niccolò da Tolentino at Rome; in which city he also designed the altar in the cappella Gabrielli in the church of Sta. Maria sopra Minerva, respectively illustrated in Rossi, *Disegni*, pl. 15-16, 23 and 28; pl. 19 being a design for the high altar for the church of Sta. Agnese in the piazza Navona at Rome; and pl. 32-3 the high altar executed by him in the church degli Angeli belonging to the nunnery of Sta. Maria Maddalena de' Pazzi at Florence. Ferri is said to have designed several palaces in Rome, but the names of his clients are not mentioned; FANTOZZI, *Guida*, 8vo., Florence, 1842, attributes to him the alteration in that city of two houses into the palazzo Orlandini del Beccuto excepting as to the cortile and entry, which were the work of Ignazio del Rosso. The chapel of S. Sebastiano in the basilica so called at Rome, is however attributed to him. He died 13 September 1689 at the age of 55 years according to most authorities (VIRLOYS, *Diet. s. n.* says 1696, aged 62) and was buried in the church of Sta. Maria in Trastevere. 5. 28. 40. 42. 62. 68. 111.

FESTINIOG SLATE DISTRICT. Festiniog is the name of a small village in the county of Merioneth, in Wales, situated about midway between the summit level of the vale of the same name and Tanybwlch, the residence of Mrs. Oakely, the principal owner of the extensive slate veins which have been designated the Festiniog veins, or sometimes the Rhiwbrydri quarries, the produce from which is shipped at Portmadoc. The district is more or less intersected by slate veins of excellent quality running from east to west, and dipping at various angles from 12° to 22° . The colours are dark grey inclining to blue, and also dark blue—those quarries that have been worked the deepest produce the finest quality of slate, which may be considered as remarkable for the even surface presented when merely split from the block as it is quarried. One peculiarity that distinguishes the Rhiwbrydri veins is a long joint which separates the superincumbent rock from the slate; this joint, from its extent and uniformity, coupled with its dip and the fact that there is always found adhering to the upper bed a thin coating or layer of clay, has secured for it the appellation of the "Clay Slant," and wherever found in the district is considered as beyond doubt overlying the slate. The quarries wherein this distinguishing feature of the district is seen to the greatest extent, and where it has been used or its existence made available for purposes in connection with quarrying, are those of the Welsh Slate Company's or Lord Palmerston's. The early history of these quarries would abundantly illustrate the difficulties often met with in working slate from its natural beds.

The slate of the Welsh Slate Company's quarries is worked out up to the clay slant, the rock above this joint being sufficiently strong to form the roof for alternate spaces of seventeen yards; separating these openings are pillars thirteen yards and a half wide, which carry the superincumbent rock. The depth of the vein on which the quarries are opened has not been proved; the depth worked is one hundred and twenty yards, and the width eighty yards. On the course of the vein galleries are opened out, rising fifteen yards above each other. Two other quarries beyond those of this Company are worked on the same vein, but are not so large, or, proportionately, so

productive. The sizes and weights of the slates from the Welsh Slate Company's quarries are as under:—

Description of Slating.	Size.		First Quality.		Second Quality.	
	ins.	feet.	Weight per 100.	cwt.	Weight per 100.	cwt.
Princesses	24	14	3	10	4	0
Duchesses	24	12	3	0	3	10
Ditto, small	22	12	2	15	3	5
Marchionesses	22	11	2	10	—	—
Countesses	20	10	2	0	2	10
Viscountesses, wide	18	10	1	15	2	5
Ditto	18	9	1	10	—	—
Ladies, wide	10	10	1	10	2	0
Ditto	10	8½	1	5	1	10
Ditto, small	14	8	1	2	1	5
Ditto	14	7	1	0	—	—
Donbles, large	13	7	—	15½	—	—
Ditto	13	6½	—	15	—	—
Headers	14	12	1	12½	—	—
Ditto	14	10	1	7½	—	—

Ton slates, in Queens, 28, 30, 32, and 36 ins. long, of various breadths; Bags, seconds, of various breadths; Sawn slabs, etc.

Although the Rhiwbryddir quarries are the most extensive now in operation, it must not be understood that they comprise the whole Festiniog district. The number of quarries now in operation consist of eleven shipping from Portmadoc; and several others are being opened out.

Another quality of slate is found in the Festiniog district, to the south of the Rhiwbryddir quarries; this is dark blue in colour, and approximates nearer to the Caernarvonshire slate in general texture and character; but in consequence of this part of the district being far from the line of railway leading to the shipping port, extensive quarries have not yet been opened out, but it is in contemplation to construct a branch line of railway, three and a quarter miles in length, from the Festiniog Slate Quarry Company's works to a junction with the Portmadoc line, which will facilitate the development of this Company's estate, and when opened out will be productive in roofing slates and slabs of excellent quality; and be also the means of enabling other minor quarries to bring their produce into market at a remunerative rate.

O. H.

FESTOON (It. *festone*; Sp. *foliages*; Fr. *feston*; Ger. *fruchtschnur*). An ornament originally consisting of foliage entwined by ribands, subsequently increased by the addition of more ribands interlaced with foliage and flowers; then with flowers and fruit; and finally with instruments of science, art, trade, etc. Such an ornament is naturally thickest in the middle: when it hangs down from one end only of the riband it is called a drop; but when it hangs from both ends it is called a swag. As usually employed upon friezes or vases it consists of a swag with two drops beyond the knots of the riband, the ends of which are disposed as an additional ornament, and the space over the centre of the swag has a patera, head, or other decoration. Sometimes the festoon consists of two half-swags, or of two curved drops, as when it proceeds from a key stone, and rests on the architrave of an arch.

FEUILLANTS. A religious order, as a reform of the CISTERCIANS, established 1577, for the strict observance of the monastic rule of S. Bernard, at the abbaye de N. D. de Feuillants, about eighteen miles from Toulouse.

40.

FEVRE, (.....LE) of Orleans, designed the hôtel de Senetaire at Paris, engraved in the *Grand MAROT*, pl. 24.

5.

FEZ, in Arabic *Fas*. A city founded A.D. 805-6 in Morocco. It is divided into two portions El Caroubin (Alcarvin or the Cairvanese of CONDÉ) and Andalusia, separated and surrounded by walls much damaged by the artificial flood employed in the siege, 1145. The narrow and dirty streets are darkened by the projection of the first floor of the houses, an inconvenience increased by the galleries or passages with which the upper stories are connected. Few of the houses, which are all flat-roofed, have windows to the street, and many are so decayed as to require props. Of the two hundred mosques there are but three that are not small and mean, viz.: that of the Sultan Muley Edris in the portion called Andalusia, having the finest and tallest minaret in the city; that in the part El Caroubin,

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the only mosque accessible to women; and that belonging to the palace. The two first are coeval with the foundation of the city; the enlargement and the new dome of El Caroubin were completed 954-5. Numerous public baths, several hospitals inclusive of one richly endowed now restricted to the reception of lunatics, and about two hundred caravanserais are the other principal buildings. CONDÉ, *Domination*, 12mo., London, 1854, i, 394, 446, ii, 9, 445.

14. 50.

FIAMINGO, sometimes written **FIAMMINGO** (IL), see **BOLOGNA** (G. DA), and **VANSANZIO** or **VASANZIO** (G.), both of whom are sometimes simply mentioned as **Giovanni FIAMINGO**.

FIBRE OF IRON. When iron bars present somewhat of a filamentary or stringy character, and do not break with a clear, bright, crystalline fracture, or grain, but rather seem to be composed of a number of threads interpenetrating, the iron is said to be of a fibrous nature. Fibrous iron is soft, ductile, and remarkably pure; but it is, on account of this very purity, exposed to rapid oxidation in damp positions, and to become *red short* when reworked in the furnace or in the forge. For wire drawing, chain cables, boiler plates, gun barrels, nails, horse shoes, and other works requiring the iron to be modified in its shape in working, fibrous iron is the most desirable; but for many other purposes, as hammers, chisels, anvils, rails, spikes, columns, nails, bolts, and spikes, the more dense and crystalline irons are preferable; because they are harder, and have more 'body', as the workmen say, even though they are less pure, and are exposed to be occasionally *cold short*. The best Welsh, or the Low Moor irons, are very fibrous; the Swedish and the best Staffordshire irons are more crystalline. In all cases the fibre of the iron runs in the direction of the length of the bars, and it seems to be attributable to the operation of the lamination they have undergone. Its effect upon the resistance of the iron to loads appears to be that the bars in which it exists extend and compress easily, but resist lateral strains very successfully; on the other hand crystalline iron resists vertical forces (whether of compression or of extension) in a more decided manner, even whilst it is unable to resist cross strains in the same degree as fibrous iron. ROGERS, *Iron Metallurgy*, 8vo., London, 1855, states that the fibre of iron is entirely an artificial result, produced by the treatment of the metal after it leaves the puddling furnace; but it would certainly appear that unless definite proportions of carbon are present, in combination with the iron, the latter cannot be rendered fibrous by any mechanical treatment. MUSHET, *Papers on Iron and Steel*, 8vo., Lond., 1840. G. R. B.

FIBROUS SLAB, or **PATENT WOOD**. The name given to an invention patented 24 Feb. 1851 by C. F. Bielefeld, which consists of a fibrous material rolled into slabs or sheets. It combines many of the properties of wood, and is adapted in a superior degree to almost every purpose to which the various descriptions of wood as well as plaster are applicable. Wood-work beyond the ordinary width of a board is made by the junction of two or more boards by gluing up, an operation involving much labour and expense, and attended with all the contingent risks of shrinking, expanding, splitting, winding, etc., as well as the natural imperfections of knots, shakes, etc.; but the patent fibrous material is at once manufactured in slabs of any required thickness, length, or width. It is considered to be unflammable; a non-conductor of heat; poisonous to vermin; easily worked, although equal in density to the hardest woods; readily adapted to any curve; eligible as the base of veneers for cabinet work; and always ready for immediate use. Possessing these properties it is applicable for large panels, ceilings, floors, partitions, and in conjunction with iron joisting; thus assisting to secure fire-proof construction.

The dome 140 ft. diam. of the Reading-room of the British Museum, designed by S. Smirke, R.A. 1856, is constructed internally of this material; the sizes of the panels composed of three pieces are 22 ft. long by 11 ft. 6 in. wide, and were raised in their spherical form to a height of 110 ft. and fixed in one

piece to the iron work of the roof. The chief advantages derived in this case from its use were that it was wholly free from any moisture; and presented a surface on which gilding and painting could be performed at once. It is also found to have a resonant property advantageous for lining rooms destined for musical purposes. It has been used for the lining of a conservatory at Constantinople without exhibiting any defect after four years exposure to a trying atmosphere. This material forms the groundwork of the concave and ogee fronts of the boxes in the Adelphi theatre, London, designed by T. H. Wyatt, 1858; and in that building it was also used as casing to the iron stanchions supporting the roof. At the New Opera house, Covent-garden, designed by E. M. Barry, 1858, the ceilings generally throughout the house, the large domical ceiling included, are formed of this material. It has also been used in the reception rooms of the London Necropolis Company at Woking; the London and Westminster Bank, S. James's-square, and other places.

The slabs (un inflammable) can be manufactured, it is said, of any required thickness, from $\frac{1}{4}$ to 1 in., provided the sizes do not exceed 14 ft. by 6 ft. Ordinary slabs, rough, of that size range in price from 2d. to 7d. per foot super., if surfaced 1d. per foot extra per side, and if cut to sizes $\frac{1}{4}$ d. per foot extra. When used for outside work or any place exposed to damp or frost, a coat of asphalt in coal naphtha should be applied, after which it can be painted as ordinary work. The weight of this material, one inch thick, is 4 lbs. per foot super.

Slabs (flammable) for paneling, rolled between canvas, of uniform thickness are used for sign boards, covering for vans, and other light purposes. The thicknesses made are $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{1}{2}$ in. which are charged at an average price of 4d. per foot super.

FICTITIOUS ARCHITECTURE (Fr. *architecture feinte*).

A representation of architectural forms and features on a smooth surface, the outline of the different parts being shown in perspective; and the shadows projected so as to obtain the effect of solidity; while the aid of colour, in shades even of a single hue, assists in giving an appearance of reality; this is frequently enhanced by the employment of all colours in imitation, as effective as it is ingenious, of the various materials that might have been employed had the fictitious structure been substantial. The effect of simulated gilding is sometimes aided by the introduction of real metal in thin lines where the supposed surface would reflect light to the spectator's eye; portions of such pictures have been modelled in relief, sometimes absolute for the main features, at others partial for details, skilfully taken back into the groundwork. In Italy many buildings have all the features of an elaborate architectural composition painted on their different elevations. Between Nice and Genoa there are frequent instances of villas gaudily ornamented in this manner; the latter city in particular offers perhaps the largest number of congregated examples of this subject. The vaulting, &c. of the cathedral at Milan, and the dome of that in London, are instances of this method of decoration, which is in fact a system of producing pictures of architecture upon the scale, sometimes exceeded, of probable reality.

A. H. M.

Girolamo Curti, called il Dentone, Michael Angiolo Colonna, Agostino Mitelli, and Marcantonio Chiarini, have generally been cited as remarkable practitioners, partly in Germany and in Spain, as well as in Italy, during the seventeenth century, of this species of decoration which, in its relation to theatrical scenery, was understood by the ancients, (VITRUVIUS, vii, 5), revived by Peruzzi, and practised with great success by the Bibienas and Servandoni; whose best efforts (so far as can be judged by the sketches and engravings that remain) have been frequently surpassed in England by the ephemeral productions of artists whose names are hardly remembered, although their works might have served as studies of architectural design. PUTEUS (Pozzo), *Perspectiva*, fol., Rome, 1693 and many other editions, is a mine

of instruction for the correct delineation of such pictures according to the nature of the surface to be covered and the point of sight. FLORENTINE MOSAIC; INTARSIA TURA. 5. 23.

FICUS Carica, the fig tree of Europe and West Indies. As the wood shrinks much in drying, it is of little value, except for fuel. The leaf of the fig tree has been suggested for adoption in sculptured ornamentation. 71.

F. Sycomorus, the sycamore fig (Arab. *Djummel*), which is planted extensively in Egypt, has been supposed to have furnished much of the material used by the ancient Egyptians for mummy cases, &c.; but FORSKAHL, placing it among the trees which are used for firewood, excludes it from the list of carpenter's woods; and DON conjectures that the timber really used was supplied by Cordia Myxa. 14.

Various species are found in the woods of Nepal, East Indies, many of them giving a soft, light wood; one called *doodae-kath* being used for gutters.

A species called *thubbo*, in the forests of Tavoy, East Indies, is used in house carpentry.

F. undulata, *bakhalpant*, in the forests of Gualpara, East Indies, is an open, soft, rather tough wood; and used for canoes; while F. oppositifolia, *khoskadumar*, in the same forests, is a soft, open, and brittle wood. 71.

F. elasticus, see CAOUTCHOUC.

F. religiosa, *pepal tree*, is the great enemy of buildings in India. It grows by preference on brickwork, and if once the roots get into a crevice, they split the strongest wall in a very few years, and tear domes, especially, to pieces: *Papers*, Royal Inst. of Brit. Archts., 1854-5, 16.

FIELD, see FELDE.

FIELD'S BROWN; FIELD'S RUSSET, Madder Brown, or Russet RUBIATE. A colour prepared from the *rubia tinctoria*, madder root; it is a pure, rich, transparent and deep russet of a true middle hue, between orange and purple. The three hues, orange russet, russet or madder brown, and purple russet or intense madder brown, are said not to be subject to change by the action of light, impure air, or mixture with other pigments. The last dries best in oil, the others but indifferently. 9.

FIELD'S CARMINE, or Madder Carmine, principally differs from rose lakes of madder in its texture, and in the greater richness, depth, and transparency of its colour, which is of various hues from rose colour to crimson. These hues are said to be the only durable carmines for painting either in water or in oil. 9.

FIESOLE, the ancient Fæsula, Festolæ, Fesula, or Fesulæ. The seat of a bishopric in Tuscany. In consequence of mediæval migration to the neighbouring city of Florence, Fiesole now consists merely of a humble palazzo del comune, a few houses, and the ecclesiastical buildings. One of the inclined lintels of an Etruscan gate is to be seen in part of the old uncemented walls that are built of stone, generally squared and laid, although oblique joints often occur, in horizontal courses with blocks of sandstone (*macigno*) varying from 1 to 3 ft., but averaging more than 2 ft. in height, and ranging from the square of their height to 7 and even 12 ft. 6 in. in length; there are also remains of an ancient paved road made of large rectangular flags furrowed transversely to make a sort of *cordonnata*; the mouths of two sewers; and a Roman arch; within the walls are part of the outer circuit, a few seats, and a flight of steps to five vaults, of a Roman theatre (below and east of the cathedral) that was sufficiently excavated 1819 to exhibit, before it was covered again with earth, proofs that it had six gates in the outer circuit, and twenty ranges of seats with five flights of steps: besides two or three other vaults, there is a remarkable tank (discovered 1832, but reclosed 1833), which was covered by the convergence of several horizontal layers of thin stone, and the imposition of larger slabs in the centre: DENNIS, *Cities*, etc., 8vo., London, 1848, ii, 118-34, who also gives some details of the neighbouring Fonte Sotterra, which appears to have been intended as a substitute for the above named reservoir. The cathedral, erected 1023, and dedicated to SS. Pietro e Romolo, but not completed till the fourteenth century, is described by WEBB, *Eccles. Sketches*, 8vo., London, 1848, p. 352, as consisting of a nave and two aisles with a low open wood

roof; and as having a round-ended apse over a confessional, the altar being placed between one choir in front and another (but smaller) at back, as at Torcello; the marble *dossale* between the two flights of steps at the ends of the ambulatory is by A. Ferrucci; the sixteen pillars are built of stone in small courses, with capitals and bases from older buildings; in 1840 this edifice was undergoing restoration; the campanile, which is 230 ft. high, dates from 1213. Near it are the magnificent *seminario* erected 1637, but recently enlarged by P. Poccianti; one of the episcopal palaces (another being at Florence); the *pretorio* dating from the thirteenth century; the *casa canoniale*; the church of Sta. Maria Intemerata or Primerana, having a rich portal executed in the sixteenth century; and the quarries opened by Brunellesco for his works at Florence. The same writer notices that on the top of the highest crest of the hill that is crowned by the town is a small Franciscan monastery, with a most humble church having nothing remarkable but a seven-foiled arch under a gabled and corbelled canopy as a portal; and the low built church of S. Alessandro, believed to date from 526. This structure has a nave separated from its aisles by semicircular arches which exhibit classic detail much modernized, and rest upon sixteen columns of *cipollino* marble with capitals chiefly of an Ionic order, and corresponding bases of white marble. In 1784 the roof was taken down and the rich pavement was removed in order to turn the site into a cemetery, but the church was restored and enlarged 1814-8 by Giuseppe del Rosso. An hospital, or rather alms-house, and a nunnery date 1570-1605. Lower down the hill is the Badia di SS. Romolo e Bartolommeo, formerly the cathedral, which was founded 1023 as a Benedictine monastery, but transferred 1439-40 to the Canonici Lateranensi Regolari, for whom the elder Cosmo de' Medici built 1456-62, excepting the retention of the old (twelfth century) façade of the church, the present structure, which according to VASARI cost 100,000 scudi. This establishment, one of the finest works of Brunellesco, consisting of a handsome monastery, an elegant cortile, and a well-proportioned church, became 1778, when the abbey was dissolved, a villa of the archbishop of Florence; it was dismantled 1810, but somewhat repaired 1815; since which it was partly occupied by the celebrated Inghirami, who here engraved and published his works on Etruscan antiquities.

On the roads to Florence are a bridge of a single arch over the river Mugnone; the suppressed monastery of S. Domenico founded 1404, its church is said to have been designed by Brunellesco, but much altered, especially with the tribune executed by Dosio and with the external *loggato* 1635 by M. Nigetti; the villa di Doccia, formerly a monastery and church dedicated to S. Michele, erected by Santi di Tito from a design of M. A. Buonarroti; the villa Ricasoli, founded 1400 as a monastery and church dedicated to S. Girolamo, designed, like the neighbouring villa Mozzi, by Michelozzo; and the village of S. Sano or properly S. Ansano, which has been thought worth a special work by MOISIUS TRAMONTANUS, *Descriptio*, etc., Venice, 1798. 28. 50. 96.

FIESOLE (ANDREA DA) executed the tombs of the Saliceti family, respectively dated 1403 and 1412 in the churches of S. Martino and S. Domenico at Bologna. 105.

FIESOLE (MANGONE DA), a pupil of the sculptor Andrea Ferrucci of Fiesole, designed several palaces and houses at Rome. 5. 73.

FIGLINUM (sometimes written FIGULINUM) OPUS. These Latin words undoubtedly convey the idea of burnt clay: and in VITRUVIUS, v, 10, would seem to mean a lining of tiles beneath a wooden floor; he writes, "Sin autem contignationes fuerint figlinum opus subjiciatur," etc. It will be noticed that *figlinum*, and not *signinum* as has been suggested, is retained as the correct reading because the latter term, as elsewhere explained by the same author, means 'concrete,' and would be absurd. The word *figlinum* is not elsewhere employed by that author; but it stands without suspicion

in a difficult, and probably corrupt, portion of PLINY, *Hist. Nat.*, xxxvi, 64; where the same translation would suit so much of the text as is certain. His words are, "lithostrota acceptavere (or coeptavere) jam sub Sylla parvulis certe crustis exstat hodieque quod in Fortunæ delubro Præneste fecit: pulsa deinde ex humo pavimenta in cameras transiere e vitro novitium et hoc inventum Agrippa certe (another reading is, transiere ut pronum vitium et hoc inventum Agrippa certe) in thermis quas Romæ fecit figlinum opus encausto pinxit in reliquis albaria adornavit: non dubie vitreas facturum cameras, si prius id inventum fuisset, aut a parietibus scenæ, ut diximus, Scauri pervenisset in cameras." Whether 'e vitro novitium' be a corruption of a marginal note 'e Vitruvio (vii, 1) vitium,' or any other reading be adopted, *figlinum* opus clearly means a wall lining of large tiles, described by VITRUVIUS, vii, 4, as similar in material to his ceiling noticed v, 10. As 'encausto pinxit' can apply only to 'figlinum opus', it is easy to see that the use of either phrase for enamel or glass mosaic is an error in those writers who, like others before the latter half of the last century, still consider that 'encausto pinxit' meant work in enamel, whereas it has been shewn to have been painted in wax or with a wax varnish, as noticed s. v. *Encaustic*; especially since PLINY himself explains LITHOSTRATA as made 'parvulis crustis'.

FIGLINUM OPUS, in general terms expressing only 'fictile work' and therefore primarily applicable to the manufacture of vases, terra cottas, and such like, has, in its special relation to the subject of mosaic, been described by DIGBY WYATT, *Specimens of the Geometrical Mosaic*, fol., London, 1848, p. 5, as the third great generic variety of ancient mosaics, which "would appear to have been what is now generally called *lavoro di smalto*,—that is, mosaic composed of minute portions of a compound of silice and alumina, (coloured by the addition of one of the metallic oxides), but possessed of a much larger proportion of the former material than now in use by the modern Italians."

In support of this view, that author has kindly forwarded the following references to, and extracts from, various writers, prefacing them by noticing his statement (p. 3) of the attempts made by commentators to distinguish the mode of fabrication, but without complete success; and alleging that CIAMPINI, *Vet. Mon.*, fol., Rome, 1690, p. 81, was at least the most intelligible; and that he (Mr. W.) should "adopt as far as possible his analysis of the subject." CIAMPINI's designation of 'figlinum' was applied with reticence by Mr. Wyatt, he using the phrase that "this variety of mosaic would appear to have been the *lavoro di smalto*." He adds that neither by CIAMPINI, nor perhaps by any other writer on ancient mosaic, is any hesitation shewn in accepting the words 'e vitro' as applied to mosaic, and as connected, vaguely perhaps, with opus figlinum in the disputed passage, to which CIAMPINI thus alludes (p. 81); "Post Syllæ tempora hominum ingenia per artium apices gliscentia, præstantius se exercuerunt, adeo ut etate Agrippæ pavimenta figlini operis encausto picti, sternere cogitaverint, ut habetur ex Plinio supracitato." It may be unnecessary perhaps to remind the reader how many ancient pavements exist in which marbles, hard and soft stones, pure glass, and earthenware are combined; sometimes one, and sometimes the other class of material preponderating. It is not difficult, therefore, to imagine that mosaics may have existed composed at first of stone and marble only; then of stone, marble, and what is usually understood as fictile or earthenware; then of earthenware alone; then mixed with glass; and ultimately the more brilliant material might gain the ascendancy: the original term applicable to such mosaic remaining unchanged through any transitional phases the art may have assumed.

Few recent writers have gone more elaborately into PLINY's meaning in this and other passages of the *Natural History*, illustrating the art of mosaic, than the Padre SECCHI, librarian

and professor of the Collegio Romano. In his *Il Musaico Antoniano Descritto e Illustrato*, 4to., Rome, 1843, p. 11, he thus renders the disputed passage: "I pavimenti a smalti esigliati dal suolo passarono a fregiar solamente le volte delle stanze"; and adds "that it is clear from his writings that PLINY draws a distinction from their material between two kinds of mosaic, that made of stony substances, and that made of pastes artificially coloured, assigning to each a separate mode of practice and nomenclature. He interprets PLINY's ascription of novelty not to the use of 'smalti' (fictile or vitreous pastes) in combination with marbles or other materials, or indeed alone, in pavements, but to their employment "to adorn the vaults of apartments". He ingeniously establishes the identity of the Grecian *ἀσκληροί* with the Roman tessellæ, and quotes PLINY as showing the former to have been made of glass, susceptible of being coloured (by heat), in the following words (*Hist. Nat.*, xxxvi, 67). Speaking of glass, "tingit ars, veluti quum calculi fiunt, quos quidam *abaculos* appellant, aliquos etiam pluribus modis versicolores." Hence even in the absence of corroborative remains, the Padre SECCHI would infer from the writings of PLINY alone, and altogether irrespective of the disputed passage, the fact that mosaics might be and were made either in fictile or vitreous materials, or in such a combination of the two as might be produced by glazing metallic oxides with fluxes of the latter over 'bodies' composed of the former class of substances. Thus SPRETI, *Compendio Istoricco del Arte di Comporre i Musaici*, 4to., Ravenna, 1804, p. 2, declares that the term 'mosaic' is applied "dagli scrittori, anche ad un certo plasma di terra cotta, che messa in polvere, rimpastata e indurita al fuoco, si riduceva in segmenti più, o meno grandi, coi quali poi coloriti, con varie tinte di *encausto* (which in a foot note he defines to be a 'materia adusta per dipingere a fuoco') anticamente si copriva il suolo, e spesso ancora le pareti delle nobili abitazioni."

With respect to the word 'encausto' as used above by SPRETI, and especially the application of the words 'encausto pinxit' to 'opus figlinum' being an argument against the fictile or vitreous character of the mosaic described, and probably designated as 'opus figlinum', it would appear that no terms could better point to that material 'glass' and its combinations, than which PLINY himself says in the same chapter, "nec est alia materia nunc sequacior, ac etiam *picturæ* accommodatior." The term 'painted' is to be found in other authors of good latinity applied to mosaic, as in SPARTIAN, *Life of Pescennius Niger*, a representation of the hero is described as "*pictus de musivo*" in a portico in the gardens of Commodus. Again, TREBELLIVS POLLIO mentions portraits of Aurelian and others "*picta omnia de musco*." Again, in the best writers of the sixteenth and seventeenth centuries on the subject of mosaic, PLINY's terms applied to 'opus figlinum' present no difficulty. Thus FURIETTI, *De Musivis*, 4to., Rome, 1752, p. 25, in speaking of the Egyptian processes of glass making as probably practised by the Greeks, says that "nova ars prodiit *vitri* frustula varie colorata, et *encausto picta* in lapillis secandi, ut ita musivariis artificibus, quibus prestò non essent variegatorum marmorum calculi, non deesset, quod operi perficiendo necessarium ducerent." And thus CIAMPINI himself (p. 81) describes the revival of the most ancient form of 'opus figlinum' "hujusmodi operis species hoc tempore in lucem est revocata, cum et hic aliquæ privatorum cameræ, et Venetiis ferè omnia, talibus figulinis operibus *encausto pictis* pavimenta sternantur." To limit the meaning of 'encausto pinxit' to wax painting would be to render the term 'encaustic tiles' ridiculous, and to leave the Italians without a derivation for the word 'inchiostro'. M. D. W.

FIG TREE, see FIGUS.

FIGUEROA (LEONARDO DE) succeeded F. Gomez Septier as maestro-mayor of the collegiate church of S. Salvador at Seville, which he continued nearly to completion, having erected 1702 the brick cupola, when he was superseded 5 August 1711 by Diego Diaz, who finished the work 1712. His designs, and those of his son MATIAS, made 1725, for the decoration of

the royal collegio of S. Telmo in the same city, were preserved in that establishment, where the works that remained to be erected at the temporary completion in 1734 were resumed 1775 under the grandson and son of the preceding architects, ANTONIO MATIAS, who erected its *seminario de nobles*, which was finished 1796. 66.

FIGUEROA (MIGUEL DE) of the same family as the preceding, was resident 1692 at Seville, when for that city he designed the church of S. Pablo of the Preaching Friars, which was completed 1708. He afterwards was engaged by the Jesuits to construct the church of their Noviciate, this building was not completed until 1731. 66.

FIGURE OF WOOD, see CURUL.

FILAGREE, see FILIGRANE.

FILARETE, see AVERLINO (ANTONIO).

FILE, (It. and Sp. *lima*; Fr. *lime*; Ger. *feile*). One of the oldest of tools, for it seems to have preceded the grindstone, according to HOLLAND, *On the Progress, etc., of Manufactures in Metal*, in LARDNER'S *Cab. Cyc.*, 8vo., Lond., 1831, i, 297-315. It is made of steel, having a surface so notched by a straight and sharp chisel as to exhibit a series of fine teeth, and is employed for the abrasion of metal, stone, wood, horn, etc. A 'single-cut,' or 'single float' file, has teeth consisting of parallel furrows or scrapers, raised either at right angles to the length of the tool, or in a direction oblique to that length; it is used upon brass, copper, and the softer metals; and is considered to work best when the teeth are laid obliquely. A 'double-cut,' or 'cross-cut' file, is such a file crossed at a second cutting by a similar set of furrows laid at an angle oblique to the preceding series of scrapers; and thus has its face formed into a series of teeth admirably adapted to the abrasion of wrought and cast steel and iron. Proceeding from the finest, the various degrees of coarseness are known as 'dead-smooth,' 'smooth,' 'second-cut,' 'bastard-cut,' and 'rough.' The very heavy square files used by smiths are sometimes a little coarser than the rough, and are called 'rubbers.' Files are also distinguished by the shape of the section across them, as 'round,' 'half-round,' 'three-square,' 'four-square,' and 'flat,' and all these varieties are generally made tapering. Files are technically distinguished from RASPS, which have the teeth formed in quincunx by a sharp triangular-pointed punch, but some of the deepest and coarsest 'cross-cut' files are also known by that name. Tough and very white files are composed of 88.18 zinc with 11.82 tin. The best files of English make are chiefly manufactured at Sheffield and Warrington; but very delicate files for watch-makers are also successfully made in Switzerland. Sir John Robison's plan of making half-round files is given in the SOCIETY OF ARTS *Transactions*, 8vo., London 1843, liv, 128. Powers's patent files or rasps, described in the CIVIL ENGINEER *Journal*, 1855, xviii, 427, do not appear to have obtained popularity.

It has been stated that Mr. G. Cumberland, having found the wear of steel files rather expensive, has been induced to seek a substitute for abrading hard bodies; and has discovered that clay may be employed for this purpose. Wet pieces of this substance folded up in muslin, cambric, and Irish linen, forced by the pressure of the hand into the interstices of the threads, so as to receive a correct mould, and then well baked, form a new species of file, capable of destroying steel itself, and very useful in cutting glass, as well as in polishing and rasping wood, ivory, and all sorts of metals: ACKERMANN, *Repository of Arts*, 8vo., London, 1810, iii, 381.

FILLET, an old way of writing FILET.

FILIGRANE, also spelt filagree, filigree, fillagree, or filligree; filigrane or filligram; filigrain or filigrane; filligraive; filligraen; and even philigram (1707) in NISBET *Heraldry*, fol. Edinb. 1742, ii, 294 (It. *filigrana*; Fr. *filigranne*, now said only to apply to what is called in English a 'papermark,' *filigrane* and *filigrane*, both disused, and *filigrane*). A kind of ornamental work in which flowers, etc., are formed

of fine gold and silver wire, curled or twisted in a serpentine form, and sometimes plaited and worked through each other, and soldered together. WREN, writing from Paris, says 'works of filgrand and little knacks are in great vogue,' *Parentalia*, fol., London 1750, p. 261. SWINBURNE, *Travels through Spain*, 4to. London, 1779, p. 417, observes "that the churches of our ancestors shoot up into spires, towers, pinnacles, and filigree work." Speaking of 'the elaborate canopies and minute ornaments used in tombs, sepulchral chapels, and the shrines of saints, commonly called *tabernacle-work*,' DALLAWAY, *Anecdotes*, 8vo., London 1800, p. 21, notes that 'the earliest instance of this minute workmanship, which has been termed *filligraine*, is the choir of the cathedral at York, about the close of the fourteenth century.'

FILIPPINO DEGLI ORGANI, see MODENA (FILIPPINO DA).

FILIPPO (IL MAESTRO) is noticed s. n. by MILIZIA, who has been copied by GWILT and others, as a Spaniard and the restorer 1512 of the cathedral at Seville which, finished 1506, became ruinous 1512. The dome completed 1507, appears to have fallen 1511, but no architect of repute in Spain at that time had this appellation except Felipe de Borgoña or Vignari, whose name never occurs authoritatively in connection with that edifice. Although Pedro de Morales was *maestro-mayor* of the cathedral 1512, it really was restored and without a dome, by Juan Gil de Hontanon, who completed his work 4 November 1519. The mistake seems to have been caused by an error, corrected by CEAN-BERMUDEZ in LLAGUNA, *Noticias*, 4to., Madrid 1819, i, 204-6, that may probably be traced to GONZALEZ DAVILA, *Historia*, 4to., Salamanca 1606.

FILIPPO (LORENZO DI) was engaged, after Orcagna, on the cathedral of Sta. Maria del Fiore at Florence, as appears by extracts from the registers dated 30 August 1384, at seven florins per month; and 11 August 1396 at eight golden florins per month as *capomaestro*: BALDINUCCI, *Notizie*, 8vo., Florence, 1845, i, 334. NAGLER mentions a Filippo di Lorenzo, perhaps his son, who 1421 began building the vault of the cupola before Brunellesco was employed. LORENZO (F. DI).

FILISTER, often written FILLISTER, but sometimes and probably more correctly PHILISTER. The technical name for a species of rebate-plane. Of this there are two kinds: the side-filister or moving-filister, fitted with a moveable stop so that the stuff may be brought to any regular gauge, or a rebate sunk to any given depth; and the sash-filister which is a similar tool used for sinking the rebate for the glass on sash-bars, and is a union of the *rebate* and *plough*, with shifting sides, and regulating stop, but the plane, plane-iron, etc., are exactly like a rebate plane. Arundle's improved filister is described, with diagrams, in the SOCIETY OF ARTS *Transactions*, 8vo., London, 1841, liii, part i, 94. Filistering is now done by machinery. A. A.

FILLAGREE and FILLIGREE, see FILIGRANE.

FILLET (old English FELET, which is explained to be a narrow, flat, or horizontal molding, by DALLAWAY, *Discourses*, 8vo., London, 1833, p. 174. Latin *fascia*, *regula*, *tenia*; It. *listello*; Sp. *filete*, *listelo*; Fr. *filet*, *liste*; Ger. *leiste*). A narrow and flat member used to separate one molding, ornament, or surface, from another, and to give breadth and firmness to the termination of a molding or suite of moldings as at the top of a cornice. According to the place in which it is used, it is called ANNULET, BAND, FILLET, LISTEL, and SQUARE: while *cymbia*, which has been referred to 'fillet,' yet is not noticed under that word by GWILT, *Encyc.*, seems to be the same term as *cimbia*, that in NEVE (like 'cimby' in his copyist the BUILDERS DICTIONARY, 1734), is referred to 'pedestal' without being noticed under that word: BRITTON, *Dict.* gives another meaning of *cimbia*, a 'fillet, band or cincture round the shaft of a column'. In joiners' work, one fillet at least is involved in the idea of a torus, but not in that of a bead. In some cases, especially in work that is vertical, the assemblage of two or more fillets is very effective, but this result does not

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always happen in horizontal work internally, as in cornices, ceilings, etc. 19.

The fillet (Fr. *cote*) employed between the flutes of a shaft, is sometimes very slight, as in the case of the columns of a Doric order at Priene, and the temple of Nemesis at Rhamnus, as well as to the propylæa at Athens; at other times it has as much as one-third of the width of the flute; and examples varying between these extremes may be found in most designs of the classic and neo-classic orders, except in the Tuscan; and in the Doric of the baths of Diocletian, at Rome, which is fluted; and of Palladio, Barozzi and Viola, who show unfluted shafts. VITRUVIUS, iii, 3, intimates that in the Ionic order, its width should be equal to the amount of entasis (*adfectio*) given to the shaft. Such fillets are generally plain but they have been grooved, as in a fragment at Athens, given by INWOOD, *Erechtheion*, fol., London 1827, p. 156, fol. 36, fig. 9; and in another of similar character at the church of S. Pancrazio in Rome, shown by PIRANESI, *De Romanorum Magnif.*, fol., Rome 1761, pl. 8 and 19, who gives seven other examples of the divisions between flutes, including one consisting of a torus with a square and bead on each side, which is also seen in two shafts at the church of Sta. Agnese fuori le mura at Rome, in which city the Pantheon shows in its inner Corinthian order a bead upon the fillet.

NEVE, *Builder's Dict.* 1736, s. v. explains it as "a little member in the ornaments or mouldings, by some called *listel*, by others *girt*. In painting, gilding, etc., it is a little rule of leaf gold, drawn on the edges of frames, mouldings, or pannels."

In old works a fillet is sometimes described as any small piece of wood less than a batten. And at present the name is also given to a small narrow piece of wood used to carry the end of a shelf, or to serve as a stop to a door, when the fillet is usually return beaded on the edge: or to cover a joint of a lining, ledged door, etc.; in the latter case the French technical term is *couvrejoint*. ARRIS FILLET; EAVES BOARD; EAVES CATCH; EAVES LATH; EYE BROW; FEATHERED FILLET; FEATHER FILLET; TILTING FILLET. 10.

FILLET is also used as a synonym for a ribbon, occurring in architectural sculpture, as on the heads of statues, on the horns of victims at a sacrifice; as binding fruit and flowers, and foliage, together, etc.

FILLET GUTTER. A name sometimes applied to a gutter between the sloping part of a roof and a chimney shaft, or any similar projection. It is so called probably because it consists merely of a small lear board and fillet, laid to receive the lead. A. A.

FILLETING. An economical substitute for lead flashing at the junction of a roof with a wall. Fillets are commonly run on the slating, and thus in the event of any settlement, they become detached from the wall or slating, and water penetrates. Filleting is of two kinds; 1. of lime and hair mortar, which adheres equally to brickwork, slating, and tiling: and 2. of cement, which separates more or less from all of them; when properly executed, the cement should be run on nails and tarred twine, so as to be dependent on the brickwork rather than on the roofing; if the slating be well laid and have the needful tilting fillets, it is possible that the desired security may be obtained. French architects use the term *filet* for a stone string course used as filleting in mediæval work, and *filet de couverture* for a plaster band about twelve inches high run along a wall to cover the junction of a penthouse roof. 25.

FILLING (Lat. *cæmentum*; It. *cimento*; Fr. *blocage*). The materials, chiefly stone with lime and sand, used in backing or hearting a wall; at some times being rough rubble or brick work, at other times a sort of concrete: the failure of large piers in a mediæval building, often attributed to their want of strength to resist thrust, may frequently be traced to the lime in the filling having become powdery. Filling to the spandrels of arches has been noticed s. v. CONCRETE.

FILLING is also the proper name for the earth thrown back into the trenches made for foundations when the walls have been sufficiently carried up: and is also applied to earth used to back up retaining walls, in which case there is always a risk, especially if the new ground be at all wedge shaped, that the bottom of the wall will be sapped by the drainage water, and that the face of the wall will bulge towards the bottom.

FILLING IN PIECE. A name given to a timber, of a less length than that with which it may range, used for filling in small irregular spaces; as the jack-rafters next the hip of a roof; the short rafters fitted in the side of a roof next to a chimney shaft; the short quarters between the braces of partitions; and the similar work to groins, pendentives, etc., fixed to receive the laths. A. A.

FILLING IN STUFF. A mixture of whiting, size, etc., applied to work which is intended to be painted in imitation of wood or marble. It is thoroughly rubbed into the grain of the material in the same way as coach pannels are prepared for painting, and is then pumiced down to receive the priming. A. A.

FILOTESIO (NICOLA), called Cola or Nicola dell' Amatrice, established himself at Ascoli in the Papal States, about 1500, where he erected several of the public buildings, inclusive of the external façade of the cathedral. In the architecture of the first order of the church of S. Bernardino di Siena (1525-42) at Aquila, not far from Amatrice, in the kingdom of Naples, is the inscription, "Cola Amatricius Architector instruxit." 3. 5. 28. 62. 96.

FILTER. A machine by means of which the impurities of water are removed. Sometimes filters act chemically, so as to take out the substances which may be in solution in the water or other fluid to be passed through them; but, as a general rule, filters only act mechanically, and are not able to effect any other object than the removal of the matters which are in mechanical suspension. The filtration of water through animal charcoal, or through the magnetic oxide of iron, on Spencer's patent, seem to be the only processes at present known by means of which chemical impurities can be removed on a large scale; the magnetic oxide of iron possesses even the power of taking out the peculiar colour of peaty water. It has been supposed that filtration through the broken amygdaloidal rocks, or through burnt ballast of mild clay, would answer the same purpose, but the practical results of their application have not been successful. As to the filtration of water for the purpose of removing matters in suspension, it is habitually effected by passing the water through layers of sand and gravel, or by passing it through filtering slabs of natural or artificial stone of a permeable character. One consequence of either of these actions is too often overlooked, and it is therefore important at once to call attention to it; namely, that precisely in proportion as the filter discharges its function of arresting impurities, so must it tend to become choked; and therefore, in constructing any artificial filter, it is important to provide means for examining, cleaning, or replacing, the filtering medium.

The filters used for town supplies or other purposes for which large quantities of water are required, are usually made in England of several layers of sand gradually increasing in the volume of its particles in descending, and resting upon layers of gravel also of increasing dimensions; and, in the lowest course of gravel, perforated tiles are laid through which the water flows into the reservoir. The water is supplied on the top of the filter so as to stand at a depth of from 4 to 6 ft. over the sand and other filtering media. At the Lambeth Water Works these media consist of: 1, a layer of sand 3 ft. thick; 2, a layer of clean sea shells 6 ins. thick; 3, fine gravel 6 ins. thick; 4, coarser gravel 6 in. thick; 5, very coarse screened and washed ballast 6 ins. thick; and 6, pierced tiles covering the drains. At the Southwark Water Works the filtering media are rather thicker; at Hull the sand is 2 ft. thick, and the gravel 1 ft. 4 ins. thick; at York the sand is about 4 ft. thick, and the gravel 4 ft. thick;

at Paisley the sand is 2 ft. thick, and the gravel only 6 ins., but the upper part of the sand is mixed with animal charcoal. Local conditions must regulate the proportion of these materials, for the thickness of the sand must be increased according to the impurity of the water; and it is desirable when the water is of a very turbid nature, to make settling reservoirs by the side of the filtering basins in which as much of the mechanical impurities as possible may be deposited. The alluvial matters brought down by winter rains are specially liable to choke the upper surfaces of sand filters, and the subsiding reservoirs are principally of use in guarding against their action. The growth of weeds in summer is the greatest evil to be contended with in open filter basins, and it sometimes takes place with such rapidity in England as entirely to stop the action of such filters as those of the Lambeth Company in three days. The usual yield of filtered water from a basin established under the preceding conditions is about 80 to 100 gallons per foot superficial per day.

The large area required for such filters constitutes a very serious objection to their use; and it may therefore be desirable to add that it appears from the experiments recorded by DARCY in "*les Fontaines publiques de la Ville de Dijon*, Paris, 4to., 1856," that the yield is almost directly proportional to the height, measuring from the top of the outfall drain to the surface of the water over the filter. Taking the thickness of the filtering media e in feet, and the head of water in feet, H , if the yield when $e+H=5+4=9$ be 100 gallons per foot superficial per day, it would become 200 gallons per foot superficial per day, if H were made 13 ft., or in other words, if $e+H=18$ ft. The thickness of the filtering media has even a greater influence than the head of water upon the yield; but as the quality of the sand affects this question in a very singular manner, it is not advisable (in the present state of knowledge on the subject) to note more with respect to the laws of the passage of water through the said media than that the yield seems to be in the direct inverse ratio of the thickness. With some waters the quality of the filtered water appears to be improved by the length of time during which they remain on the filter, so that the architect must adapt his practice in this respect to the peculiar circumstances of the case with which he has to deal.

In some situations the materials forming the bed of the stream resorted to as a source of water supply may be made to serve as the filtering media; for if they should consist of fine sand and gravel all that would be required would be to form permeable tunnels in them for the purpose of leading the water to a reservoir. Filters of this kind were formerly used in the Clyde; they are still used at Nottingham, Perth, Toulouse, Lyon, &c.; but they are liable to the serious objection that their yield is the least in the summer months (on account of the diminished head), or precisely at the period when the demand is the greatest. With proper care, however, these natural filters may be easily maintained in a state of efficiency, and they seem even to yield larger proportionate results than ordinary artificial ones. The filter tunnels at Perth yield about 335 gallons per foot superficial per day; those at Toulouse about 450 gallons.

Houses built in districts where there are no springs, or where wells are not easily sunk, as for instance, upon broad plateaux of chalk, sandstone, or limestone, at considerable elevations above the level of the water line; or upon clay lands—are compelled to depend for their supply of water upon the collection and storage of the rain falling upon the roofs. In such cases the water is much exposed to contamination by the dust, leaves, and other impurities, which accumulate between the intervals of the showers; and it is also exposed to undergo a species of decomposition, or at least a chemical change, whilst in the tank or reservoir. The necessity for filtration becomes the more necessary under these circumstances, and it would be desirable to effect that operation in such a manner as to eliminate both the chemical and the mechanical impurities. This

might be effected, partially by the system adopted in the "Pays de Caux," where the rain water tank is separated into two divisions by means of a cross-wall, or diaphragm, of a filtering stone; the rain water inlet pipe communicating with the larger, and the pure water exit pipe with the smaller, division. The stones used for this purpose are either the very porous limestones filled with fossils, the fibrous volcanic rocks, or the coralline rocks; and it is very rarely indeed that they filter at a more rapid rate than sixty gallons per foot superficial per day; their thickness must be regulated by the differences of the levels of the water on either side of the diaphragm, and by the resistance of the stone, provided the latter can be obtained of a sufficient length to pass from wall to wall, and be bedded at each end in the latter. If the stone should not be of this length, the diaphragm must be built in the same manner as any ordinary wall intended to resist the maximum difference of levels. Another mode of effecting the simple mechanical filtration is the one adopted at Venice, described in the *COMPTES RENDUES de l'Académie des Sciences*, 25 July 1860; it consists of—1, a water-tight enclosure; 2, a well of dry brickwork in the centre of—3, a bed of sand filling up the remainder of the enclosure around the well; and serving partially as a reservoir, and partially as a filter; the rain water filters into the well through the sand. This system is also shewn in the *BAUZEITUNG* for 1836, p. 159-60, and pl. 556; and is also described by PARKER, in *Transactions of the Roy. Inst. of Brit. Archts.*, 4to., 1842, 187.

Both these systems of filtration might be made to act chemically, by causing the water in the first case, to pass through a diaphragm composed of two slabs of filtering stone, spaced at a small distance from one another, and filled in with animal charcoal, or with the magnetic oxide of iron. In the second case, all that would be required would be, to place the charcoal or magnetic oxide near the well. It may be desirable also here to add, that the oxide seems from recent experiments to be the best filtering material for the class of water usually collected from roofs; because it both absorbs and parts with its oxygen with singular rapidity, and whilst it thus communicates easily the oxygen so commonly deficient in tank water, it is itself susceptible of a rapid revivification. The animal charcoal loses its active powers when a volume of water, of the ordinary tank quality, equal to between 1500 and 2000 times its own weight, has passed through it; but it also is capable of revivification. Nevertheless, in the majority of cases, the first cost, and the subsequent expense of the charcoal is greater than that of the magnetic oxide; and the oxidation of the water is not effected by the former in the same satisfactory manner as it is by the latter; the quantity of water the oxide will filter before revivification may be taken as being also rather more than the quantity which would be purified by the charcoal. A double wall such as is above described, ought, if built of good filtering slabs, to pass 100 gallons per foot superficial per day. Ransome's patent silicious stone is the best material of the kind ordinarily obtainable in England.

Some attention was called to a system of filtration by ascension a few years since, and it was actually applied at Southampton, in precisely the reverse way to which it should have been; for the water was made to rise, firstly through filtering slabs, and then through sand. Fortunately the water in this case was very pure, and the slabs answered very well for a long time, but at last they became choked, and then the whole filter had to be taken to pieces. In fact, it is as necessary to provide for the cleansing of a filter, as for the placing of the materials at the commencement; and this cannot be done when the filtration takes place *per ascensum*.

The cost of filtration on a large scale, without any allowance for the interest of money, appears to be about 1s. 2d. per million gallons; on a small scale, it is about 2d. per 1000 gallons.

C. R. B.

Filters of porous sandstone, such as those made at Halifax, are recommended as perfectly effective and very durable. The close texture of the stone causes the exclusion of all, even the minutest, substances, so that the water passes through, leaving on the outside all the impurities, whence they are easily removable. STIRLING's filter is described in *CIVIL ENGINEER Journal*, 1849, xii, 159. A cheap filter for domestic purposes is recommended to be made by a large zinc funnel capable of holding about a gallon of water placed over a jar or other vessel from which the filtered water can be easily drawn off. The stem of the funnel is to be packed to the depth of 5 ins. with fine white sand, and above this with a stratum 2 ins. thick of coarsely ground animal charcoal, such as the sugar-bakers employ. The sand and the charcoal are to be well washed before they are put into the funnel, and a disc of perforated zinc is to be placed at the bottom of the stem to prevent the sand, etc., from running out. An instrument constructed in this way will keep in perfect action for a long time, and when it fails it is easily repaired by re-washing the sand and charcoal.

The *Transactions of the Roy. Inst. of Brit. Architects*, 1850-51, give the paper and discussion on the different systems of filtration in use for the supply of large towns, by G. R. BURNELL, C.E., read June 2, 1851. *Reports of the Commissioners for inquiring into the state of large towns and populous districts*, 1844, etc., contain many references to this important subject.

RONZANI and LUCIOLLI, *Le Fabbriche di M. San Micheli*, fol., Venezia, 1832, gives the 'Cisterna detta dei cinque pozzi di Zara', for supplying filtered rain water to that fortress.

FINAL. An old term for "an enrichment on a funeral monument, representing the end of life, viz.; a boy without wings, holding in his hand an extinguished torch, fixed on a death's head at his feet."

FINCH (the Hon. HENRY) was surveyor-general of the Board of Works from about 1744 to his death 13 July 1757.

FINCK (JOHANN GEORG), educated as a stone mason at Augsburg; removed 1741 to Berlin, where he acted as *condukteur* of the opera house, under Knobelsdorf, and engraved four plates of that building; as *landbaumeister* and *landbaudirekter* at Cassel, he designed many country houses, and died 1756 aged 56 years.

FINEER. This word, which is used in PAIN, *Builder's Pocket Treasure*, 8vo., London, 1763, p. 62, corresponds to the term 'development' as employed by GWILT, *Encyc.*, § 1996, appears to have been applied to the surface of a gore of a sphere, or else to the thin flexible template itself for that surface.

FINNIER.

FINE STUFF. The material used for the last coat in ordinary plastering. It is sometimes made by scattering water over lime and then sifting them through a fine sieve; but it is more usually "run," that is, the lime is washed through the sieve with water till it becomes as thick as washed clay, and is suffered to stand some days before it is used. It is then mixed with a proper quantity of hair and fine sand, and then laid on thinly and well trowelled. This coat thus applied is called the *setting coat*. COARSE STUFF; FIRST OR PRICKING-UP COAT; FLOATED WORK.

A. A.

FINIAL, in old English FENYAILLE and FINOL. This term has only of late years regained in some degree its mediæval sense of what is usually called a PINNACLE. The church at Fotheringhay 1435 was to have its buttresses 'fynisht with fynials'; the chapel of King's College at Cambridge 1461 was to have 'every butterace fined with finials'; battlements and 'fynallis', are noticed in the accounts for 1474 at York, as shown by BROWNE, *History of the Cathedral*, 4to., London, 1847, p. 254, and the north and south aisles of the church at Burnley 1533 were to be finished with buttresses, 'every buttress having a funnel upon the top'; WHITAKER, *History of Whalley*, fol., London, 1818, p. 323. Under this term therefore would be included the upright stem of the so-called pinnacle,

with its capping, molding, gablets, and spirelet; or with such of those features as the designer pleased: and to this article would belong notice of the mode of setting out such a finial, as detailed in the fifteenth century, by RORICZER, given in *Detached Essays*, 1848-49, extracted from REICHENSBERGER, *Das Buchlein von der Fialen*, etc., 4to., Treves, 1845.

In modern times the word first meant what is now generally expressed by its true mediæval name of *crop*, viz. the carved or sculptured termination of any pyramidal portion of a building in a mediæval style; whether a ball, a fleur-de-lis, a cluster of foliage, an animal, or a figure, as at Peterborough, etc.: and in such a sense reference ought to be made to the clever, but not altogether convincing diagrams of proportion given in BOISSERÉE, *Histoire, etc. de Cologne*, 4to., Munich, 1843, p. 78-80. Of late years it sufficiently expressed the upright stem supporting one, or more than one, such crop, and sometimes carrying two or more of the crockets that decorate the external edges of gablets, canopies, hoodmolds, spires, pinnacles, etc., in mediæval work: but in general the crop is understood to be included in the finial.

FINISHER, or FYNYSHER. The following curious example of the use of this term is given in LODGE, *Illustrations*, 4to., London, 1791, p. 207, as part of a letter 1578 from Gilbert Talbot to his father, the Earl of Shrewsbury: "I received your L.'s letter on Wednesday last, by the fynyshe, and, accordyng to your pleasure, have taken order that he shall have good glasse to worke, and a room in Shrewsburye House to lye in, and to worke it; and after that he hath fynysshed the glasse, he may take in hand the mendinge of suche roomes in that your L.'s house, by rougcastyng them, and seelyng them, as there shall be neede of, and then the season wylbe better for that purpose then it is now."

FINISHING. A term popularly applied to the completion of a building; or of the work by each separate trade employed on a structure; but it frequently means the joiners' work in architrave, skirting, etc.; and, technically, the last of the coats of plasterer's work, which finishing is called a *SETTING-COAT* if prepared for paper, but if executed in a manner proper to receive paint is either *BASTARD* or *TROWELLED STUCCO*. 1.

Indeed the word would appear to have recently meant all the coats of external plastering involved in the operations indicated by the following extracts; the church of S. Mary Magdalen, Bermondsey, rebuilt 1680 'of brick rendered over with a finishing', AUBREY, *Surrey*, 8vo., London, 1719, v, 43; and the church of S. Martin Outwich, Bishops-gate-street, pulled down about 1797, 'was of brick and stone covered with a finishing, WILKINSON, *Antique Remains*, 4to., London, 1797.

FINISHING (Fr. *amortissement*). An old term for "a crowning, or other ornament, raised over a building to complete it," such as the *CORONER* of a window, or the pierced pseudo-gable in Elizabethan work. 4.

FINISHING COAT (Fr. *Blanc des Carmes, or de Sentis*), see *FACED WORK*, in painting.

FINK (CONRAD), of Constance in Switzerland, educated as a mason, acted as foreman (*obergesell*) in the erection of the conservatories and stables designed by Neumann at Seehof, for the bishop (of Constance), who made him a master-mason. On that prelate's death he was engaged as *hofmaurermeister* by the bishop of Bamberg, for whom he built the Erbacher-hof, the probstei, afterwards the Irren-haus, the Kanzlei of the monastery of Michelsberg, and a portion of the university that was to have been constructed in the old Burgershof. NAGLER, who suggests that as he died 1782 he consequently could not have been born 1644, as stated by JAECK, *Pantheon*, does not affirm that the above works were designed by Fink. 68.

FINK (LORENZ), son of the preceding, was born 1754 at Memmelsdorf. The story told by JAECK, *Pantheon*, of the education as a mason, the self-tuition in drawing and in the science of building, the engravings made by the son, in Paris, of three pavilions in the garden of the monastery of Michelsberg;

the return 1769 from that city; and the immediate nomination as *churfürstlich baumeister* at Erfurt, when Fink was only fifteen years of age, appear sufficiently incredible to NAGLER, who proceeds to state that the bishop of Bamberg having named him *hofwerkmeister*, employed him 1785 to build the great Krankenhaus completed 1788; to lay out the Ludwigsstrasse; and 1792 to give the ground plan of the new monastic and external domestic buildings of the abbey at Langheim, of which the greatest part was destroyed at the secularisation. JAECK insists that he superintended with extreme credit all the public buildings from 1769 till 1806; and NAGLER appears to admit that he made all the necessary drawings. He died 1817. 68.

FINNIER and VEINIER. Modes adopted by workmen in 1708, of writing VENEER. In 1688 it was spelt FINEER.

FINOL, see FINIAL.

FIODA, see TIODA.

FIORAVANTI (RIDOLFO, or BARTOLOMEO DI RIDOLFO), see ALBERTI (ARISTOTELE).

FIOR DI PERSICO. (Fr. *marbre fleur de pêche*). The Italian name adopted in England for an antique marble having a white ground enclosing large lilac or violet angular spots. This is perhaps a variety of violet breccia; but the quarry is no longer known from whence this marble was obtained. It is believed by COUSI to be the ancient Marmor Molossium obtained from Epirus. Several chapels in Rome are named by him as being lined with slabs of this beautiful marble: some of its varieties are extremely rare, and several marbles have been improperly classed with this: Serravezza marble with a white ground showing purple spots and veins, has been called *fior di persico*, *pavonazzo*, *persecchino*, etc.; and Massa marble, from Torno and Tambura, is not unlike it: BRARD, *Mineralogie*, 8vo., Paris, 1821, ii, 298, 347, 353.

FIorentINO (ANTONIO) called Della Cava from his birth-place near Naples, having studied at Rome, built 1559 the church of Sta. Catterina a Formello for the Padri Predicatori di Lombardia at Naples, with a cupola that has been supposed, without any apparent reason, to have been the first erected in that city. He died, (according to TICCOZZI, *Vite*, s. v. Antonio, at a very advanced age) in 1570. 3. 95.

FIorentINO (GIOVANNI), see FIRENZE (FRA SISTO DA).

FIorentINO (LUCA), of Mantua, was engaged about 1500 on the cathedral at Milan. 27.

FIorenZA, see FIRENZE.

FIORINI. So much confusion has arisen about different persons of this name at Bologna, that it is necessary to state that RAFAELE and GIAMBATTISTA were brothers, that GIAMBATTISTA, who became 1570 the public architect, was the father of GABRIELE, a sculptor; and that RAFAELE had a son PIETRO, to whom the following works are assigned by most authors, except MUZZI, *Annali*, 8vo., Bologna, 1844, vii, 347, who notices GABRIELE as the author of the façade of S. Mattia; the porta Pia; the portico and church of S. Giovanni Battista; the church della Carità; and that of S. Barbaziano converted to lay purposes. It is stated that PIETRO was named 27 April 1583 public architect jointly with G. B. Ballerini, and that few works were executed in the city that were not designed or directed by them. To PIETRO is assigned the rebuilding 1570 of the church of S. Nicolo di S. Felice (this may have been by GABRIELE) modernized 1753; the erection 1583 of the church of the Franciscan monks called the padri della Carità (the four angle chapels were added 1680 by G. B. Borgonzoni); the rebuilding 1585 of the church of the Dominican nunnery of S. Mattia; the rebuilding 1597 of that of the nunnery of S. Giovanni Battista which was altered and enlarged by M. A. Bianchini; and 1608 the church of S. Barbaziano for the padri Girolamini; besides the porta Pia; and (which may have been by Giambattista) the gateway and cloister to the Olivetine monastery of S. Michele in Bosco outside Bologna. BOLOGNINI-AMORINI, *Vite*, 8vo., Bologna, 1841, v, 400, says that he was alive in 1640, which, if true, makes it extremely probable that the credit of

some of the above works is really due to GABRIELE; but the remark might apply to SEBASTIAN, son of Pietro, who rebuilt 1624 the church of S. Isaia at Bologna. 94. 105.

FIR. Strictly speaking the term fir timber is applied to the produce of any tree of the coniferous tribes known as ABIES, and PINUS, but in building it is used in a limited sense. Formerly in specifications no timber would have been called "fir," or suffered to be used when so described except Memel, Dantzic, or Riga: at present the best Archangel timber, and the best quality of red pine are considered as fit to rank as fir timber; while spruce, inferior Swedish dram, Lower Port red pine, etc., are never admitted in good work; and yellow pine is rarely used except for moldings, and sometimes for panels. For the names of the places exporting the best European timber, see BALTIC TIMBER: for red and yellow pine, see CANADIAN TIMBER. DEAL. A. A.

In carpentry, fir timber is classified by measurers and in price books; thus,

FIR NO LABOUR, timber brought to the works in sawn scantlings, the labour of conversion of which is charged elsewhere, either by the square or by the day. The value of this item is thus estimated. To the prime cost of the timber add cartage; sawing, which will depend on the size of the scantlings; waste, which is also dependent on the same, but is generally reckoned at five feet cube to the load; and profit—from fifteen to twenty per cent., and reduce the price of the whole to the foot cube.

Suppose the price of Memel fir in the docks is £4:7:6 per load of 50 ft.	s. d.
- - - - -	87 6
Rummaging (i.e. getting the floating balks out of the water); loading, and carting to the builder's yard or the saw mills—this varies of course with the distance, but say -	2 6
Sawing; varying according to the scantling; but suppose the average to be 300 ft. super to every load—at 4s. per 100 ft.	12 0
Carting to the building—as before—say -	2 6
	104 6
Add profit 15 per cent.—say -	16 6
	121 0
Allow 5 ft. cube in every load for waste—and therefore divide by 45, instead of 50 ft.—121÷45 is nearly -	2 9
The price books generally give this item -	3 0

FIR IN BOND, etc. Timber used as bond, plates, lintels, wood bricks, templates, and other timbers built into or bedded upon the walls. The price includes all the labour of halving, scarfing, dovetail laps, caulking, bedding (if not in brick walls), etc., and is generally fixed by adding from 4d. to 6d. per foot cube to that of the last item.

FIR FRAMED. Any fir which is framed but not planed, as in girders, binding and bridging joists, trimmers, dragging ties, partitions, braces, heads, cills, rafters, tie beams, struts, pur-lins, etc., though some measurers separate this item into FIR FRAMED, and FIR FRAMED AND TRUSSED, and allow for the former 4d. to 5d. per foot, and for the latter 7d. to 9d. per foot more than for FIR IN BOND.

FIR WROUGHT. Timber which has been planed on two or more sides. It is usually subdivided, as 1. Fir wrought framed; 2. Fir wrought framed and rebated; and 3. Fir wrought framed rebated and beaded; or 4. Fir in proper door or window cases. The value will depend wholly on the quantity and quality of the labour bestowed on each; and will sometimes range as high as 2s. to 2s. 6d. per foot more for the last item than for FIR NO LABOUR. A. A.

FIR CONE, see PINE CONE.

FIRE. Amongst the numerous causes of the destruction of edifices, that of fire is generally as disastrous as any other in this country; and consequently the architect is not only called upon to guard against causes which may originate a fire in his buildings, and to put together materials in such a manner as to resist combustion, but is frequently commissioned to make surveys when premises have fallen a prey to flames caused by circumstances foreign to building. Besides the works men-

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tioned s. v. FIREPROOF BUILDINGS, those referring to the originating mediums are the Annual Reports made by the Fire Brigade, given in the MECHANIC'S MAGAZINE; *Resolutions of the Associated Architects with the Report of a Committee Appointed to Consider the Causes of the Frequent Fires*, etc., 8vo, London, 1792; PAPWORTH, *Notes on the Causes of Fires*, 12mo, London, 1853.

FIRE ALTAR, see ALTAR.

FIRE BRICK. A brick used to line furnaces, etc., being manufactured of such materials as are calculated to stand the action of fire. The clay of which such bricks are made should be free from iron, which becomes a peroxide by intense heat and thus destroys the brick; and also from calcium, or any earthy salt that would render it liable to fuse. For some time Stourbridge fire bricks have been preferred in the London market, but latterly a very good fire brick has been made in Wales and elsewhere. Fire bricks are manufactured in other localities, as by the Kinsen Company, Poole, Dorset; the Hurlford works near Glasgow; at Newcastle, etc.

A better brick still has just been brought into the market called the Dinas fire brick, and is manufactured by the Ynismudu Company near Swansea. It is coming fast into extensive use in smelting works, reverberating furnaces, etc. Its power of resisting intense heat is very great. The writer has been shewn furnaces lined with this in which also a few Stourbridge bricks had been worked: the heads of the latter had been melted off by the action of the fire, while the Dinas brick was uninjured. A. A.

The fire brick of Merthyr Tydvil is made from the "fire clay," a stratum of which is often overlaid by coal; and the "farewell rock," is a species of stone composed of quartz blended together by a silicious cement. Upon this rock rest the whole of the coal and iron-stone measures. The brick is used for lining the interior of blast furnaces, and the hearth is constructed of the stone.

Fire bricks were made at Hedgerley and Gerrard's Cross, in Buckinghamshire, whence they were carried to Windsor and sent by water as "Windsor bricks," and "Hedgerley bricks," to London. They have a fine red colour, are nine inches long, four inches wide, and about one and a half inch thick; and are used for furnaces, kilns, etc., as they stand the greatest violence of fire heat; BUILDER'S MAGAZINE, 4to., London, 1774, p. 59.

Fire tiles and lumps for fire work are generally made, the former, from 9 ins. to 24 ins. square, increasing in size every two inches; the latter beginning at 12 ins. square, increasing by two inches at a time to 30 ins., then to 33 ins. and 36 ins. The Welsh and Newcastle productions are about half the price of those of Stourbridge.

The BUILDER Journal, vii, 466, mentions the erection at Edinburgh in 1849 of a tenement in which fire brick alone was employed, in blocks of the size and appearance of hewn stone, about two feet long by fourteen inches deep, with others of eighteen to twenty inches long by six and a half to nine inches square, the advantage being its resistance to fire and damp.

As to the resistance to damp, the writer of this paragraph has used, in Glasgow, fire clay drain-tubes made in the neighbourhood: and some circular work requiring the ends of some of these to be bevelled off, brought out from an intelligent workman the remark that by leaving them under water all night, they would cut readily with the trowel in the morning; showing that, though resistive of fire, the material, unless glazed, was permeable to, and not qualified to contain or to exclude, water. J. W.

FIRE CLAY. A description of clay used for the purpose of making bricks, tiles, or vessels intended to be exposed to great heat, as in the case of furnaces, boiler or retort settings, crucibles, and seggars, in porcelain factories. It differs from ordinary clay in this respect, that it contains a very large proportion of the silicate of alumina with rather an excess of silica, and very small proportions of lime and of the metallic

oxides usually found in clays. From the analysis given by Mr. C. Cowper and by Dr. Richardson, the composition of the best English fire clays is as follows: No. 1 being Stourbridge; No. 2, Monmouth; and No. 3, Newcastle, clays.

SUBSTANCES	No. 1.	No. 2.	No. 3.
Silica - - - - -	63.3	75.3	48.55
Alumina - - - - -	23.3	16.8	30.25
Oxide of iron - - - -	1.8	1.0	4.06
Carbonate of lime - - -	1.3	0.9	1.66
" magnesia - - - - -	trace	trace	1.91
Water and organic matter - -	10.3	6.0	10.67

The bricks made from these clays differ in colour, for when the oxide of iron is present in large quantities the bricks become of a dark red, and sometimes even of a blue tint; thus the Newcastle bricks are of a much darker colour than the Stourbridge, or the Alloa, bricks, and the commoner description of Welsh bricks are also of a dark tint. The force required to crush a good fire brick is said by BEARDMORE, *Hydraulic and other Tables*, 8vo., London, 1852, to be equal to 5,500 pounds per inch superficial; and its specific gravity may be taken as being between 2.2 and 2.6.

Generally speaking, the fire bricks used for furnace settings, or for retorts, are set in fire clay instead of in mortar; because the heat of the furnace would destroy the latter, whereas it causes the fire clay to become partially fused round the bricks.

G. R. D.

FIRE CRACK. The great cause of the failure of cements in molded work is that the workmen will use pure cement for mitres, while for the rest of the moldings they put a proper quantity of sand; this is the cause of the 'fire cracks', as they are called.

A. A.

FIREDOG, see ANDIRON; COBIRON.

FIRE MARBLE, see LUMACELLE.

FIRENZE or **FIORENZA** (Lat. *Florentia Tuscorum*; Ger. *Florenz*; Engl. *FLORENCE*) the capital of Tuscany. The only mark of the Roman period is the Via torta defining the extent of an amphitheatre; MANNI, *Notizie istoriche intorno al Parlago*, and a plan given by FANTOZZI, *Firenze disegnata*, 4to. Florence, 1846. The city, the seat of an archbishopric, is divided by the river Arno, over which are the following six bridges; the ponte S. Fernando, a suspension bridge, 1837, but replaced since its destruction in 1844: the ponte Rubaconte da Mandella, 1236, popularly known as the ponte alle Grazie, said to have been built by Jacopo or Lapo il Tedesco, and much damaged 1557; the piers still carry semi-detached houses in pairs; this bridge, formerly of nine arches, but of seven only since 1846, is now 570 ft. long and 24 ft. wide: the ponte vecchio, on which goldsmiths and jewellers still occupy shops, 105 ft. wide, was rebuilt 1333-45 by Taddeo Gaddi, with three segmental arches, each 3 ft. 3 ins. thick at the keystone, the side ones being 85 ft. span, and the centre 94 ft. 6 ins. with a rise of 15 ft. and 12 ft. 10 ins. respectively; over the shops runs part of a gallery from the palazzo Pitti to the palazzo vecchio and the Uffizi: the ponte alla SS. Trinità, rebuilt 1567-70 by AMMANARO; he also modernized 1559, replacing two arches, the ponte alla Carraja, of five segmental arches 88 ft. and 57 ft. 5 ins. span, with a rise of 26 ft. 10 ins. and 12 ft. 5 ins. respectively, altogether 435 ft. long and 24 ft. wide, of which the piers were laid by Jacopo il Tedesco 1218 and rebuilt 1333 by G. (da Campi) Brachetti; it still retains the name of the ponte nuovo: another suspension bridge higher up the river, the ponte S. Leopoldo, was constructed 1837.

The town is enclosed by a wall about six miles in circuit commenced 1284 by Arnolfo and finished 1330 by Andrea Pisano; this according to a decree made 1324, probably had a tower 76 ft. high at every 324 ft. in its length; but these towers, the most perfect of which are on the south side, were nearly all lowered 1527 to the level of the curtain: two forts, one to the north, and the other to the south, form part of the presumed defences. The first of these two forts, the Castello da Basso or di S. Giovanni Battista, was designed 1535 by A.

Sangallo; the latter, the castello di S. Giorgio or di Sta. Maria in Belvedere (communicating with the giardino de' Boboli), this with the small palazzo which it contains, are by Buontalenti, 1590. There were formerly sixteen gates, but only eight and a postern are now used; the porta S. Frederico 1324 by Andrea Pisano; the porta a Pinti, which almost retains its original height; and opposite to the porta a S. Gallo is a triumphal arch from the design of Giado 1737, for the entry of Francesco II; and the porta a Sta. Croce with its portico on each wall outside, are the most interesting.

The streets are clean; the brick pavement was replaced about 1235 with thick polygonal flagstones channelled by grooves. The private buildings are mostly handsome, and the numerous palaces represent a sentiment of nobility, mingled with one of prison like restraint.

The cathedral, dedicated to Sta. Maria del Fiore, was ordered 1294; the first stone was laid 8 September 1296 under the direction of Arnolfo di Cambio; the apse and three great arches next it were erected before 1330; the building was entrusted 1332 to Giotto, whose design for the campanile was executed by Taddeo Gaddi; the first-stone of the nave-pillar nearest the campanile was laid 5 July 1357; when J. Talenti was *capomaestro*, and his name appears with that title 1359; as does that of Alberto Arnoldi 1359 and 1364: the piers for the cupola were ordered 1376: Filippo di Lorenzo is noticed as *capomaestro* in 1384 and 1396, RUMOHR, ii, 113-6, 160-3; the nave was covered, the octagonal central part carried up to the cornice over the large arches, and the three short arms of the cross domed, before 1407, when Brunellesco first appears in connection with the deliberations upon the work. His appointment occurred 1420 and he nearly completed the drum (not at all contemplated by Arnolfo) and designed and executed the cupola which was the first erected upon so elevated a tambour, was the first double cupola, and is still the largest in diameter, being 134 ft. 6 ins. inside; it is tied in with an oak curb scarfed with iron, and other precautions are noticed by Lewis, in *Transactions of Royal Inst. of Brit. Architects*, 1858-9, 112; its lantern was commenced 1437 and finished not in 1456 but in 1461 by B. d'Agnolo. The church was consecrated 25 March 1436, and the works ceased in 1474. The bronze door to the sacristy is by Luca della Robbia. The façade so far as commenced by Giotto was destroyed in 1588, but its features are perpetuated in MOLINI, *La Metropolitana Fiorentina*, 4to. Florence, 1820, which illustrates the edifice and the centering for the cupola as well as a very full account of the discussions upon the designs for that front to replace one executed in wood 1514 by Sansovino, and removed 1586. Although of the drawings submitted and still preserved, by Buontalenti, Dosio, Giovanni de' Medici, Passignano, Baccio del Bianco, and others, preference was given to the idea submitted by G. Silvani, yet nothing but a mere painted façade by some Bolognese artists was determined upon, until a design by Matas was partially put into execution after 1847: in which year professor DONALDSON described at the Royal Institute of British Architects, the main features of the edifice and design, and supplied the following dimensions (English) within the walls; length 491 ft. 6 ins.; length of nave 260 ft.; length of transepts 154 ft.; width of nave 53 ft. 5 ins.; width of nave with aisles 128 ft.; height of nave 137 ft. 7 ins.; the piers 10 ft. square, and 52 ft. apart: *BUILDER Journal*, 1847, v, 561; and xvi, 845. The campanile, designed by Giotto but finished by Taddeo Gaddi, is 48 ft. square, 268 ft. 6 ins. high, and cost eleven millions of florins, its first stone was laid 28 ft. deep in the foundations 9 July, 1334, but was never completed, as the piers for the spire are still visible on the roof. The largest of its seven bells, cast 1475, cracked 1704, was speedily replaced; RUNGE, *Der Glockenthurm*, fol., Berlin, 1853; and *Illustrations*, 1848-9, pl. 25. The exteriors of the duomo and of the campanile had before 1858, undergone a complete restoration; *BUILDER Journal*, xvi, 845.

The additions, perhaps including the cortile, to the *arcivescovado* are ascribed to G. A. Dosio 1574. The front of the Canonica del Duomo was completed 1826, by Gaetano Baccani.

Of the 170 other churches formerly or now existing, the history and some mediocre illustrations will be found in RICHIA, *Notizie Storiche*, 4to. Florence, 1754-62. A great portion of the ascertained facts relating to them are condensed in the following list—

Name.	Date.	Remarks.
1. SS. Agostino e Cristina ..	1640	B. Radi, completed by G. Silvani.
2. SS. Apostoli	early?	Model for S. Spirito.
3. La Badia (Benedictine) ..	rebuilt 1625	M. Segaloni. Zocchi, pl. 18.
monastery by Arnolfo ..		
Cappella di S. Stefano ..		B. da Rovezzano.
Top of campanile	rebuilt 1830	
4. S. Carlo de' Barnabiti ..	after 1626	G. Silvani.
Tribune and high altar ..	later	F. Biliotti.
Modernized	1838	L. Pasqui.
5. Sta. Croce (Dominican), ..	3 May 1294	Arnolfo, used 1320, consecrated
first stone	1420	1412.
Cappella de' Pazzi in the ..		Brunellesco, thought to be the
outer cloister		earliest specimen of the Renaissance, FAMIN, pl. 11-13. Doon.
Cappella de' Niccolini ..	1585-1660	G. A. Dosio.
Novitiate		M. Michelozzi.
Façade being completed ..		(? Begun by Pollajuolo).
on original design	1858	
6. S. Felice; façade	1457	
7. Sta. Felicità; Sagrestia ..	1392-1470	
Cappella Capponi		
External loggia	1564	F. Brunellesco.
Church	rebuilt 1736	G. Vasari, as part of corridor to
8. S. Firenze	28 May 1615	F. Ruggieri. [pal. Pitti.]
Tribune	1698	P. F. Silvani.
Façade	1715	A. Ferri.
Oratory & façade of conv. ..	1772	F. Ruggieri.
9. S. Francesco de' Vanchetoni, via del Palazzuolo ..	1602	Z. del Rosso.
10. S. Francesco di Sales ..	1700	M. Nigetti.
11. S. Frediano	rebuilt 1680-9	A. M. Ferri. [colonel Cerutti.
Second cloister	1608	A. Ferri, from design of Roman
Capella	7 or 8 cent.	G. Silvani, who modernized it the
12. S. Giovanni Battista (octagonal baptistry church) ..		A. Ferri. [buildings.
dome 88 ft. diameter		S. built by A. Pisano 1301. N. door
External facing	1288 93 or later	1400, and E. door 1424, by Ghiberti;
Baptistry consecrated	1293	all formerly gilt. Doon. Railing in
13. S. Giovanni Evangelista ..		front of door 1830 by G. Baccani.
de' Padri Scolopi, or S. ..		Black and white marble by Arnolfo.
Giovannino, enlarged ..	1579 92	By pavement over graves outside.
Staircase of monastery ..	abt. 1575-1600	
The buildings completed ..	1661	[expense.
School	mod. 1836-8	B. Ammanato, chiefly at his own
14. SS. Girolamo e Francesco ..	1515-20	G. Pagni.
15. SS. Jacopo and Lorenzo ..	1443	A. Parigi.
16. S. Lorenzo, also called ..	1435	(In former pal. Martelli) by L.
basilica Ambrosiana		Pasqui.
Sagrestia Vecchia	earlier	Rebuilt by Antonio Lapini.
Part of façade	1513-22	Rebuilt after fire by F. Brunellesco,
Sagrestia Nuova or capella ..	1523-34	and continued after his death by
de' Medici	? 1500]	several artists. Plan in FAMIN.
Cappella de' Principi ..	begun 1604	F. Brunellesco. Doon.
Campanile	1740-1	M. A. Buonarroti, with inside of
17. S. Marco (Dominican) ..	1480	entrance doorway.
Ionic side altar	1540	M. A. Buonarroti, with cupola
Cappella di S. Antonino ..	1588	94 ft. diameter?
or de' Salvati		M. Nigetti, still incomplete.
Interior modernized	1650-1700	F. Ruggieri.
Façade completed	1777-80	M. Michelozzi (enlargement only).
18. Sta. Maria Annunziata ..	1233 or 1262	G. da Bologna.
(Servite) and small cloister or atrio		G. da Bologna.
Central arch of front		P. F. Silvani.
Cappella di S. Bastiano ..	1601-15	G. Pronti.
or de' Pucci, modernized ..		Plan in FAMIN.
Chapels of principal limb ..	1448	[side by G. Caccini.
of the cross	1451-72	Sau Gallo, three others on encl.
Tribune, choir, and altar ..	? 1400	G. Caccini and G. Silvani.
Large N.W. cloister	1591	
Cappella del Soccorso ..	1372	M. Michelozzi, much altered 1651
19. Sta. Maria Annunziata ..		by M. Nigetti and F. Silvani.
d'Orbatoio		L. B. Alberti.
20. Sta. Maria degli Angeli ..	rebuilt 1700	Smone Pollajuolo.
Campanile	soon after	G. da Bologna, for his tomb.
Cloister	1621	A. Gaddi.
Large cloister		F. Franchi. Plan in FAMIN.
Cloister of sacristy		F. Ciochi.
21. Sta. Maria del Carmine ..	rebuilt 1782	M. Nigetti.
burnt 28 Jan. 1771		B. Ammanato.
Cappella di S. Andrea ..	1675-93	G. Silvani, RUGGIERI, i, pl. 76-77.
Corini		G. Mannaioni, except façade and
22. Sta. Maria Maddalena de' ..	? 1410	capella Rucciaci.
Pazzi a Porta Pitti	1470	P. F. Silvani.
Cloister (Ionic) in front ..		? Brunellesco. Completed by G.
23. Sta. Maria Maggiore	? 12 century	da San Gallo. Plan in FAMIN.
Chapels and interior	16 century	G. da Sangallo, copying an antique
		capital found at Fiesole.
		Enlarged by Buono, not by Arnolfo
		as in VASARI.
		Buoncelenti's design, executed by
		G. Silvani.

Name.	Date.	Remarks.
24. Sta. Maria Novella or ..	first stone 18	Sisto till 1280, and Ristoro da
delle Vigne (Dominican) ..	Oct. 1278-9,	Campi till 1283. Pasquale dell'
called 'sposa gentile' by ..	consecrated	Ancisa being supervisor till 1284.
Buonarroti	7 Sept. 1420	Plan in FAMIN.
Eastern side	13...-1319	Borghese till 1313, and Albertino
		Mazzanti till 1319, Rainerio Gual-
		terotti (il Greco) being supervisor
		till 1317.
The great nave and west		
aisle, the principal chapel,		
the cappella di S. Luca or		
de' Gondi, the cappella de'		
Rucellai on S. of S. tran-		
sept, cappella de' Strozzi		
or di S. Tommaso Aquina		
in N. transept, the Chiostro		
Verde or W. cloister, the		
cappella degli Spagnuoli		
(the chapter house till		
1560) commenced	1320	
Campanile	1330	
New dormitory	before 1333	
Its pavement	1337	
Chapel of S. Niccolò and	1331	
sacristy		
Antonio	1340	
Large cloister incomplete		
Sacristy finished (door		
by F. Bosch)	1350	
Refectory (sometimes	1350-3	
dated 1460)		
Library and chapel of S.		
Antonio		
Chapel di S. Niccolò		
Hospice, afterwards re-	1359	
fectory		
Dormitory continued ..	1360	
The church completed at	1367	
a cost of 100,000 gold		
forins		
The façade of black and	1348-1470	
white marble	or 1477	
The buildings 'del Papa'	begun 1418	
Cappella della Pura in	1474	
E. cloister		
Stalls in choir		
Stained glass to coro ..	1491	
Marble cantoria	cir. 1500	
Cappella di S. Girolamo	? 1565	
or de' Gaddi		
Cappella di S. Benedetto	1570 or 79	
Bianco		
Library	1629	
25. S. Martino (Camaldolese) ..	about 1535	M. Nigetti.
26. SS. Michele e Gaetano, ..	rebuilt 1604	M. Nigetti, afterwards G. Silvani.
also called S. Michele ..		Zocchi, pl. 11. Plan in FAMIN.
Bertoldo or degli Anti-		
nori, restored by Arnolfo		
Front		
27. S. Michele in Orto (Or ..	1284	
San Michele)		
Undersigned and the	1337	
chapel built round the		
picture		
Loggia walled up and ta-	1348-59	
bernae constructed ..		
Statues and other exter-	1857-8	
nal works restored		
28. S. Michele Visdomini ..	1363	
29. S. Pancrazio	1078	
Cappella di S. Spirito or	1467	
de' Rucellai		
30. S. Salvatore in Ognis-	rebuilt 1027	
santi	façade earlier	
31. S. Spirito (Augustinian), ..	1438-55	
burnt 1470, but the shell		
remained intact		
Octagonal sacristy	1500	
Vestibule (Corin.) betw.	1500	
church and sacristy ..		
Second (Doric) cloister ..	1504-9	
First (Tuscan) cloister ..	mod. 1640	
Stairs to dormitory ..		
Vestibule and chapel of S.		
Sagramento		
Coro and high altar ..	1500-1604	
Campanile		
Velluti and Crocissano		
chapels		
The Grille	1683	
32. Sta. Teresa del Gesù, ..	1628	
hexagonal church, and		
the monastery		
33. Sta. Trinità, called the	rebuilt	
'dame' by Buonarroti ..	about 1250	
Front and alterations,		
presbiterio and stairs, fine		
cloister and adjuncts ..	1593	
Usimbardi chapel		
Giovanni (Bracchetti) da Campi		
till 1389; Ottaviano Rustici being		
supervisor in 1334.		
Twice restored after being struck		
by lightning, 236 ft. 2 ins. high to		
top.		
Jacopo Talenti da Nipozzano till		
1362, to whom the sculpture and		
tracery, the capitals of the pil-		
lars, the door and window or-		
naments, the (destroyed) rood-		
left, and the old chapter house are		
all attributed.		
Jacopo Passavanti being super-		
visor.		
Finished by L. B. Alberti, or by		
G. Bettini; gate and loggia (Corin-		
thian) by Alberti.		
Modernized 1641 by Baccani.		
Baccio d'Agnolo, others say Vasari.		
B. d'Agnolo; in 1800 it was re-		
moved to museum at South Ken-		
sington, London.		
G. A. Dosio.		
Modernized 1604 by M. Nigetti.		
M. Nigetti.		
P. F. Silvani.		
Arnolfo, as a loggia for a corn		
market with a granary above.		
T. Gaddi, to receive the two upper		
stories, which remained a granary		
until the records were removed		
there 1569.		
A. Orgagna.		
A. Orgagna.		
Secularized 1808.		
L. B. Alberti or F. Brunellesco.		
B. Pettrossi.		
M. Nigetti.		
Brunellesco, finished 20 years after		
his death. FAMIN, pl. 75, 76. <i>Illus-</i>		
trations, s.v. Church-Interior.		
S. Pollajuolo, and highly praised.		
A. Contucci. FAMIN, pl. 44.		
B. Ammanato. RUGGIERI, i, 22-4.		
A. Parigi.		
G. Parigi.		
A. Contucci.		
G. Caccini.		
B. d'Agnolo (commenced it).		
Buoncelenti.		
G. Coccapani.		
Nicola da Pisa. With five aisles.		
Buoncelenti. Zocchi, pl. 14.		
L. Cardu.		

No. 5, is 380 ft. long and 125 ft. 6 ins. wide, with piers 6 ft. 1 in. thick to the nave, which is 61 ft. 10 ins. wide, the transepts are 190 ft. long, or with their chapels 242 ft.; it possesses a splendid

collection of tombs, including those of M. A. Buonarroti and of A. Galilei. 12, is the sole font for the whole city: an internal view in GALLY KNIGHT, i, pl. 19, shows somewhat of the sixteen grey granite columns; and of the white marble pavement, dating 1200, formed into patterns by black marble for background inserted. 16, plan is T shape, 260 ft. long including the cappella Maggiore, and with the aisles and chapels 107 ft. 6 ins. wide, the transept being 172 ft. long with the chapels, and 82 ft. wide with the chapels: it has attached the celebrated biblioteca Medicea-Laurenziana 153 ft. by 38 ft. 4 ins., the body of which was designed by M. A. Buonarroti about 1534, and was completed by Vasari, RUGGIERI, *Studio d'Architettura*, fol., Fir., 1722-8, i, 1-13; ROSSI, *La Libreria Mediceo-Laurenziana*, fol., Fir., 1739, gives the glass by G. da Udine; the desks are given from a drawing by S. Smirke, R.A., in *Illustrations*, 1849-50, s. v. Furniture: an apartment has been added by Poccianti 1840 for the Elci collection. 18, has a nave 211 ft. long including the tribune, and 46 ft. wide, but 90 ft. including the chapels; it is one of the most richly encrusted with marbles: one side of the piazza in front is occupied by the magnificent ospedale degli Innocenti by Brunellesco 1421-44, opposite to a portico by A. di Sangallo about 1520. 21, has a nave 278 ft. long and 63 ft. 6 ins. wide, the transept 188 ft. long with the chapels, and 37 ft. wide. 24. This church is 322 ft. long, and 92 ft. wide across the aisles, 200 ft. long in the transepts, and 63 ft. wide with chapels: in the piazza are two obelisks standing upon tortoises. 27. The exterior has been lately restored: the original church of S. Michele, so called till 1616, erected opposite by Arnolfo 1284, is now the oratorio di S. Carlo. 31, is 304 ft. long, the ailed transept is 194 ft. long with the tribunes, and both are 113 ft. wide. 33, in its piazza is a granite column from the Baths of Caracalla at Rome. The English church was built by subscription 1844. The church of S. Romolo, 1220, exhibits the peculiarity noticed in GWILT'S CHAMBERS, *Civil Arch.*, of columns having the caps placed at the base of their shafts.

The palazzo degli Anziani, afterwards del Podestà, better known as del Bargello, or chief of police, and recently as the palazzo del Giustizia, was erected about 1252 by Lapo, and altered 1345 by Agnolo Gaddi: the cortile is given in FAMIN, pl. 31: the standard braccia is marked upon its front: it was cleared 1859, leaving the noble salone, which occupies the whole height of the building except on the ground floor, where there is a room of the same size but divided by columns below it; the ceilings may have been constructed by Ristoro da Campi and Sisto da Firenze.

The neighbouring piazza de' Signori or del gran' duca, contains the Tetto de' Pisani, erected 1364, and now used as the post-office.

The palazzo Vecchio or della Signoria, had its machicolated portion constructed 1284 or 1298 by Arnolfo for the use of the Gonfaloniere and Priori; the tower that stands, as to one face, upon the front of the corbelled parapet, belonged to the case de' Foraboschi, and was 100 ft. high, but was raised by him to the height of 287 ft. to the top of its parapet, or 306 ft. to the top of the roof. The portion now used as the dogana was added a little before 1343 by A. Pisano according to some authors; others simply say that the building was altered by him; and others state that the machicolations were added by T. Gaddi; the confusion is evident, but the matter has not yet been clearly settled. A very good view is given in the *BUILDING NEWS Journal*, 1858, iv, 983. The cortile was executed 1434 by Michelozzo (its fountain was designed by Vasari), and a staircase 11 ft. 6 ins. wide leads from it to the salone, one of the largest in Italy, executed 1494 by S. Pollajuolo to accommodate the council of one thousand persons, being 172 ft. 6 ins. long, 73 ft. wide, and 62 ft. high (FANROZZI); the ceiling, raised 23 ft. by Vasari, who divided it into richly carved and gilt compartments for pictures, is surpassed by that in the adjoining *sala dell'udienza* which was commenced 1540 by B. Bandinelli, with the aid of B. d'Agnolo, but

finished by Vasari. Since 1550 the building has been used as offices; on one side is the dogana, the rest being occupied by the ministers of state, the repository for state furniture, etc. The *ringhiera* or balcony was removed 1812 by Del Rosso. Several portions are given in FAMIN, pl. 1, 20, 32, 77, and 78; and the doorway by Buontalenti, in RUGGIERI, ii, pl. 41-2, 45, who illustrates the portion by VASARI, i, pl. 26-35.

The loggia de' Lanzi, which was so highly praised by Buonarroti, and which cost 80,000 florins, had the foundations laid before 1343, but was not executed until about 1356-75 by Orgagna, FAMIN, pl. 85, and was restored 1837-40 by Pasquale Poccianti; at its back is the *zecca* or mint by Vasari, and it thus forms part of the western wing of the court of the Uffizi.

South of the palazzo vecchio is the building called the Uffizi (plan and view in FAMIN, pl. 77-79), which is considered to have been the best work of Vasari, who commenced 1560 the east side of the building which was continued after his death by A. Parigi, and encloses a court about 472 ft. long from north to south, and 115 ft. wide; the fine view by ZOCCHI, pl. 19, has been frequently reproduced; at the south end is the wrong side upwards *porta delle Suppliche* by Buontalenti. The first door out of the eastern corridor (at the north end) leads to the remains of the church (on a basilican plan) of S. Piero Scheraggio, which was secularized 1784. The ground floor of the Uffizi is occupied by government offices and tribunals, such as the *corte criminale*, which itself was placed 1840 by Domenico Giraldi on the east side in the *teatro Mediceo* built 1585 by Buontalenti, which was 182 ft. long, 67 ft. wide, and 48 ft. high: in the upper part of this theatre is the biblioteca Magliabechiana. On the second story is the *regia galleria* with its valuable contents. In the east front is the vestibule and staircase giving access to the bridge from the palazzo vecchio; that side has the celebrated antique statues, in a tribune designed by Buontalenti, the pictures, and the gems; on the west side the visitor, standing on the loggia de' Lanzi in the rooms added 1853 for the collection of drawings, passes to the bronzes, to the central hall of Niobe, completed about 1750 with the vestibules as at present by Zanobi del Rosso, and to the stairs of the corridor that runs to the palazzo Pitti. Originally an open portico, now enclosed, formed the top story of the Uffizi as a passage from the palazzo vecchio to the palazzo Pitti without going into the street: this corridor, also by Vasari who executed it 1564 in five months, crosses the river on the top of the shops on the ponte vecchio. In 1854 the portico was furnished with statues of all the celebrated men of Tuscany.

The palazzo del Comunità was commenced by Francesco della Luna and continued by Brunellesco; its door by Vasari dates about 1553.

The palazzo Pitti, 655 ft. long, illustrated by RUGGIERI, iii, 1-28, was commenced about 1434-40 by Brunellesco, but only carried for him up to the second story by Luca Fancelli; the work was stopped 1466, but on its sale to the Medici it was continued 1559 by B. Ammanato. This building is said to exhibit the first use of a balustrade, which here is made of small Ionic columns. He also designed the elliptical grotto. At the wedding of Ferdinand I, the cortile executed by L. Cardi served as a naumachium. The wings were commenced by G. Parigi; A. Parigi secured and repaired the front towards the piazza, as it was out of the upright about 8 ins. The quadrant wings were begun by G. Ruggieri for Leopold I, and finished about 1840 by P. Poccianti. The Boboli gardens do not contain anything remarkable as a work of architecture; among its principal features are the Isola Bella, a garden about 200 ft. long by 150 ft. wide (*Illustrations* 1851-52; and FAMIN), with the *vivajo* by A. Parigi; the grotto by Buontalenti; the *caffos* 1776 and the *tepidario*, both by Z. del Rosso; and the *scala del cavaliere* by G. del Rosso 1790. A bath room in this palace is given in *Illustrations*, 1854-55.

Besides the houses of Alberti, Buonarroti, now casa de' Lanfredi, and Robert Dudley, ob. 1639 (palazzo Bordonni in via della

Vigna, built by him), the dwellings which exhibit remains of early domestic architecture are those of the Mozzi, dating from the twelfth century, with its Guelphic battlements; of the Spini or Feroni, now Humbert, attributed to Arnolfo; of the Martelli in via de' Cerretani, built by him; of the Peruzzi; of the Uzzani now Capponi by Lorenzo di Bicci 1300-50; and of the Minerbetti now Santini of the same century. The torre della Vacca, or di S. Zenobio, or de' Torrigiani, or de' Girolami (eleventh century), restored by G. del Rosso in the palazzo Lamberteschi now Bartolommei is the only one remaining of those (which were reduced from 200 or 230 ft. to 96 ft. in height) resembling the structures still remaining at Bologna, at Oneglia; at S. Geminiano, and (altered) at Pavia. Among the most remarkable edifices due to past customs, are the loggie or arcaded small squares or porticoes near several of the palazzi, in which the men that were important in those days were accessible at certain times to their fellow citizens, as if at an exchange; such is the loggia de' Tornaquinci by L. Cardì; the loggia di S. Paolo by Brunellesco 1451, opposite the church of Sta. Maria Novella; that del grano by A. Parigi 1619; that de' Peruzzi; that de' Rucellai; that del mercato nuovo by B. Tasso; and that of the mercato vecchio by Vasari; three are given in RUGGIERI.

The finest palazzi in Florence, taken as nearly as possible in chronological order, are the following: Busini afterwards Gondi now Quaratesi, by F. Brunellesco. Medici, afterwards (1659) Riccardi, and now del Governo, by M. Michelozzo, usually dated 1430 but really rather later, as he was not in Florence so early; the well known four windows on the ground floor, having sills supported by consoles are by M. A. Buonarroti, and the rest of the façade is by Buontalenti, while the large staircase is the work of G. B. Foggini. Ricasoli—Zanchini by Michelozzo. Filippo—Strozzi, in the piazza de Sta. Maria degli Ughi, which is clearly by Michelozzo, though attributed to Brunellesco; the oratorio by its side was by Valentini 1816. Tornabuoni afterwards Corsi, by Michelozzo. Gondi, by G. da Sangallo, 1480-90, to whom the Antinori is attributed. Strozzi, by B. da Majano, 1489, but continued by S. Pollajuolo, who put to one side the cornice, and designed the cortile; the first story is by Buontalenti, continued by Scamozzi and by Caccini (its cortile, RUGGIERI, ii, 25-35, being by L. Cardì), the staircase by Santi di Tito, and much was done under Nigetti; a façade by G. Silvani; the cressets at the angles, and the *campanelloni* at distances along the walls are given in the *Illustrations*, s. v. Metal Work, 1848-9; Guadagni, also attributed to S. Pollajuolo. Bartolini-Salembeni 1520-9, Borgherini now Rosselli del Turco, and Taddei now Levi, by Baccio d'Agnolo who commenced the Nasi now Torrigiani that was continued by his son (not Filippo but) Domenico, who designed the Montaguti afterwards Niccolini now Boutourlin attributed to Michelozzo. Rucellai now Stiozzi-Ridolfi, (enlarged by P. F. Silvani) and its almost adjoining loggia (now walled in), both by L. B. Alberti about 1450-60. Pandolfini, designed by Raffaello Sanzio 1520, but executed after his death by G. F. da Sangallo and completed 1538 by Bastiano. Ugucione, 1550 from a design by Raffaello but ascribed to Palladio by FAMIN, and by others to Buonarroti. Acciajuoli now Corsini, altered by G. Silvani and modernized 1837 by Ulisse Faldi, Ricci now Riccardi, 1565, and Serguidi now Gerini, lately modernized; all by B. Buontalenti who brought to its present condition the still incomplete Garzoni-Venturi, and to whom RUGGIERI ascribes the Capponi; the façade of the Martelli is also ascribed to him. Vernaccia, by Ammanato to whom the Pestellini, and the Mondragone now Ambron are attributed. Giacomini now Lardere, by G. A. Dosio. Marucelli, by G. Parigi. Dardinelli, by Santi di Tito. Roberto—Strozzi, by V. Scamozzi 1605. Rinuccini (enlarged by Silvani), and the Doric loggetta at the south-west corner of the Tornabuoni now Corsi, both by L. Cardì. Scarlati, by A. Parigi. Capponi now Covoni (except the cortile which is by L. Orlandi), about

1650; Castelli afterwards Marucelli and Brunaccini now Fenzi, 1634; Coppoli afterwards Medici now Bartolommei, and Strozzi now Giaconi, by G. Silvani who probably designed the Gerini in via del Cocomero, Riccardi in via Gualfonda, and the façade of the Gianfigliuzzi now the casino de' Nobili; RUGGIERI attributes to him a palazzo Forano. Capponi or Panciatichi in via Larga, by Carlo Fontana 1650-70. Gino-Capponi, by Carlo Fontana executed 1705 by Ruggieri and Cecchini. Corsini, or at least the staircase by P. F. Silvani, 1656; who enlarged the Rinuccini by adding the Pecori to it, and commenced the Nalsini finished 1726 by P. Giannozzi. Cherici, by G. B. Foggini. Capponi now Poniatowski, in via Larga by F. Ruggieri 1740, the interior since decorated. Durazzo-Stacchini, rebuilt by G. Baccani 1824.

Besides these, mention should be made of palazzi, brought to their present condition by various alterations, as the Giugni, formerly a monastery by B. Ammanato: Pucci e Bacciocchi, by P. Falconieri: Bardi now Tempi by M. Nigetti: Guicciardini by L. Cardì and G. Silvani: Guadagni now Velluti-Zati, and Gianfigliuzzi now Fontebuoni by G. Silvani: Orlandini del Beccuto, formerly two edifices, by C. Ferri, except the entrance and cortile designed by I. del Rosso: Viviani della Robbia, by G. B. Foggini 1693: Ferroni now Magnani 1778, and Martini by Z. del Rosso. Illustrations of all these buildings will be found in RUGGIERI, and in FAMIN and GRANDJEAN; and besides these, FAMIN gives portions of the palazzi Cocchi now Serristori, attributed to B. d' Agnolo; Scala afterwards della Gherardesca 1470; Giacomini 1470; Orlandini; Ximenes now Panciatichi, commenced 1490 by G. da San Gallo, and finished by G. Silvani; and Zanopucci; while RUGGIERI gives details of the palazzo Montalvi; and the palazzo Pasquale of which the artist was unknown to him.

Many a house, *casa*, of less pretension deserves notice, such as the following; Bensole and Gherardini, by B. Ammanato; Baci, built for himself by Santo di Tito; Fenzi, by the same; Remedioti, for the Bartorelli, by G. Silvani; Sermolli or de' Cartelloni, by G. B. Nelli; Balzani, rebuilt 1834 by Paolo Veraci; Poccianti as modernized by its owner P. Poccianti; and Dofour-Berte formerly Rucellai, for which family it was brought to its present form by G. M. Paoletti.

The casino Mediceo now or lately a cavalry barrack was altered by Buontalenti, and completed by G. Silvani; the casino Corsini by the former is given in RUGGIERI, together with the casino of F. Zuccheri; the casino Riccardi, now Stiozzi-Ridolfi was designed by the latter 1638; the casino reale, by B. Fallani dates 1775; a casino in the Cascine by G. Manetti, 1787 (FAMIN); the casino de' Nobili formerly palazzo Gianfigliuzzi, enlarged 1841 by B. Silvestri; and the casino di Livia (? by Buontalenti 1570) in the piazza di S. Marco.

The theatres in chronological order are, la Pergola built 1652 by F. Tacca, enlarged 1738-40 by A. (Galli) Bibiena, containing 2500 persons in five tiers of boxes, 71 ft. 6 ins. by 48 ft. with a stage 110 ft. by 90 ft. lately restored and rendered one of the finest in Italy. La piazza vecchia, 1759, containing 800 persons, in three tiers of boxes, is 40 ft. by 27 ft. with a stage 30 ft. by 23 ft. The Borgognissanti, 1770 restored 1826, containing 1400 persons in four tiers of boxes is 53 ft. by 32 ft. 6 ins. with a stage 43 ft. by 32 ft. 6 ins. The teatro nuovo, 1779, by Mannaioni, containing 2400 persons, is 63 ft. by 48 ft. with a stage 99 ft. by 55 ft. 6 ins. The Goldoni, 1817 by G. del Rosso, contains 1600 persons in four tiers of boxes is 54 ft. by 38 ft. 6 ins. with a stage 73 ft. by 63 ft. The teatro Diurno, 1818 by A. Corazzi, is modelled on the plan of the ancient theatres, with seven *cunei*, running up to a portico of a Doric order and carrying a terrace: it contains 1500 persons, and is 80 ft. by 67 ft. with a stage 63 ft. by 31 ft. 6 ins. The Alfieri, 48 ft. by 42 ft., with a stage 82 ft. 6 ins. by 40 ft., rebuilt 1828 to contain 1000 persons by V. Bellini. The Cocomero, modernized 1830, containing 1500 persons, is 48 ft. by 38 ft., with a stage of the same width and 42 ft. deep. The

Concordi dates 1839. The Leopoldo, 48 ft. by 34 ft. 6 ins., with a stage 61 ft. 6 ins. deep, modernized 1841 by V. Bellini.

Amongst the buildings intended for charitable and educational purposes, notice may be taken of the arcispedale di Sta. Maria Nuova, with a church by Lorenzo di Bicci 1418, and a façade commenced by Buontalenti but completed by G. Parigi. The same Lorenzo at the end of the previous century designed the *liceo* founded and commenced by N. da Uzzano. Lelmo or Guglielmo Baldoni had commenced at his own expense and on his own design, the ospedale di S. Matteo 1384, altered by G. Paoletti and G. del Rosso for the accademia di Bella Arti; the spedale and church of S. Giovanni di Dio by C. A. Marcellini date 1735; the spedale di S. Giambattista or di Bonifazio was modernized 1787 by G. Salvetti, and the church later by G. B. Pieratti; the spedale di Sta. Lucia was modernized 1838, by G. Martelli. The albergo di Mendicanti modernized 1621 by G. Parigi is now the scuole di S. Salvatore. The scuole di S. Paolo, have a loggia 1451 from a design by Brunellesco, to which new columns were put 1789, by G. Salvetti, who in 1787 had modernized the conservatorio delle Signore Montalve in via della Scala. An elevation of the spedale di S. Paolo de' convalescenti is given in FAMIN.

Amongst works, of which the architects are known, should be enumerated the Ghetto, arranged 1571 by Buontalenti; the liceo reale, for which the nunnery of Sta. Maria de' Candeli was modernized 1812 by G. del Rosso, its church was erected 1703 by G. B. Foggini; the biblioteca Marucelliana, opened 1752 in a building designed by A. Dori of Rome, but executed by I. Giavannozzi; the magazzino dell' abbondanza 1695, also by Foggini; and the *mattatoi* or abattoir 1835, by P. Veraci.

In the environs of Florence notice should be taken not only of the villas all around the city, especially in the neighbourhood of FIESOLE, but of the church (modernized 1794 by G. Manetti) of the monastery di Montughi: the villa Medicea di Careggi, now Orsi, by Michelozzo: Pratolino, designed by Buontalenti, about six miles from the city, destroyed by Ferdinand III, although its description is still given in some guide-books: Cafaggiolo, erected for Cosmo the merchant-prince: the villa del Poggio a Cajano, about ten miles from Florence, designed by G. da Sangallo: the conservatorio delle Quiete with a church erected 1686 by G. B. Silvani: the villa della Petraja or real villa di Castello, about four miles from the town, which was brought to its present form by Buontalenti: the abbey of S. Paolo di Monte Oliveto with a church dating 1472: the church of S. Francesco di Paola, by G. Silvani: the villa Michelozzi, by Michelozzo: the villa del Poggio Imperiale, formerly Baroncelli, modernized 1622 by G. Parigi: the Certosa built 1341, about three miles from the city, by Andrea Orcagna, which is a fortified monastery that deserves careful study of the building and its contents; the plan is given in FAMIN: the machicolated palazzo; the disused church; and the monastery Cluniac till 1553 but afterwards Olivetina called S. Miniato al Monte; GALLY KNIGHT gives internal views of the crypt and nave of the church commenced 1013 on the plan of a basilica, and GAILHABAUD, *Monumens*, etc., ii, illustrates the building; the *confeSSIONE* or crypt is approached by steps (being 4 ft. down) from each side of the nave, while stairs from the ailes conduct to the sanctuary, a remarkable marble pavement dating 1207 occupies the nave; the *Illustrations*, 1848-9, give examples of the inlaid pavements; the upper church, or choir as it would be called in England, is arranged in divisions with a space for neophytes, a barrier, the *coro*, and the apse, in which are five windows filled in with thin slabs of Sarravezza marble; the square sacristy adjoining on the south dates 1387; the chapel of S. Giacomo was the work of Antonio Rossellino; the front of the church was executed in the fourteenth century; the handsome campanile was designed by Baccio d'Agnolo 1519: the Franciscan church of S. Salvatore del Monte

designed by S. Pollajuolo, and termed by Buonarroti, "la bella Villanella": and the villa Petti, now Rusciano, by Brunellesco.

An excellent map (for the time) is given in RUGGIERI, and another by the Society for the Diffusion of Useful Knowledge, No. 178, but the best is in FANTOZZI, *Guida di F.*, 8vo., 1842, which has been specially consulted for this article. FANTOZZI, *Descrizione dell' città*, etc. 12mo. 1842. The following works are in addition to those mentioned in the text:

BENVENUTI, *Le tre porte del Battist.*, fol., 1821; KELLER, *Portes du Baptistère*, fol., 1798; CACIALLI, *Collezione de' Disegni di nuove fabbriche etc., nella villa del Poggio Imperiale etc.*, fol., 1823; Rosso, *Richerche storico architettoniche sopra il tempio di S. Giovanni*, 8vo., 1820; GERINI, *Le vedute più notabili di F. fol.*, 1744; LANDINI, *Istoria dell' oratorio etc. della Misericordia di F. etc.*, 4to. 1843; MIGLIORI, *F. illustrata*, 4to., 1684; BIADI, *Notizie sulle Antiche Fabbriche di F.*; NELLI, *Piante ed alzati dell' insigne Chiesa di Sta. Maria del Fiore*, fol., 1755; ROBB, *Chiesa principali d'Europa*, lar. fol., 1824-31; PERINI, *Views of Churches and Palaces of F.* fol., n.d.; PIERACCINI, *La Piazza del Granduca di F.*, etc., fol., 1830; SALVIATI, *Descr. della capella di S. Ant. Arcivescovo*, fol., 1728; SGRILLI, *Descr. e Studi dell' insigne fabbrica di S. Maria*, fol., 1733; TARTINI, *Notizie e guida di F.*, etc., 8vo., 1841; ZOCCHI, *Streets, etc.*, in *F.*, fol., 1754. GAILHABAUD, *L'Architecture*, etc., 4to., Paris, 1850-59; and *Monumens*, etc., 4to., Paris, 1841-50; MARULLI, *L'arch.*, etc., della città, 4to., 1808; *Descrizione dell' Imp. Pal. Pitti*, 8vo., 1819; BOCCHI and CINELLI, *Bellezze di F.*, 8vo., 1677; GARGIOLLI, *Descr. de la ville*, 8vo., 1819; MISSIRINI, *Esposizione della Cappella de' Sepolcri Medici in S. Lorenzo di Firenze, e della grande cupola ivi dipinta*, fol., 1836; and the *Pitture del Salone Imperiale del Palazzo di Firenze; della imp. Ville della Petraia e del Poggio a Caiano*, fol., Flor., 1751. The architecture of Florence is described in *BUILDER Journal* for 1845 and 1846; examples of the corbelled cornices are given in *Illustrations*, 1849-50, pl. 31.

FIRENZE (ANTONIO DA) see AVERLINO (ANTONIO).

FIRENZE (BARTOLOMEO DA) enlarged the foundations and added the first story 1454 of the campanile to the cathedral at Ferrara.

FIRENZE (BERNARDO DA), see GAMBARELLI, called Rosellino or Rossellino, (BERNARDO).

FIRENZE (FRA SISTO DA) see CAMPI (RISTORO DI).

FIRENZE (GIOVANNI DA, and ANTONIO DA) appear in the list of architects employed upon the cathedral at Milan, under the respective dates of 1391 and 1454. 27.

FIRENZE (GIOVANNI FIORENTINO, or DA) is mentioned by NAGLER as a pupil of ARNOLFO upon the authority of BOTTARI, who has made a mistake of attaching the name of Giovanni Brachetti to the works of Fra Sisto da Firenze.

FIRE-PLACE. The hearth and opening to contain fire. PALLADIO, BARBARO, and FERRARI, have supposed fire-places in classic times; others, both before and after them, have maintained a contrary opinion, although SUTTONIUS, *Vitellius*, 8, says 'flagrante triclino ex conceptu camini'; MAFFEI has collected the reasons adduced on both sides, and has left the question undecided. PALLADIO says that the ancients, to heat their apartments, built the fire-place in the middle of the room, with columns or consoles supporting the architraves or mantles, placing upon them a pyramidal funnel (CHIMNEY HOOD) through which the smoke was conveyed. He adds that a fire-place of this kind was found at Baïæ, not far from the piscina Neronis; and another not far from Civita Vecchia: an illustration is given, from one at Bologna, in SEROUX D'AGINCOURT, *Histoire de l'Art*, fol., 1823, pl. 72, fig. 5. In Italy this fire-place in the centre of a room remained to mediæval times. JOHANNES DE MUSSIS, *Chronicon Placentinum*, in MURATORI, *Rer. Ital.*, xvi, 582, speaks of a single fire, and that only in the midst of the kitchen in each house, until 1260, and seventy years later. In South Italy the *fuoco* is still in the middle of the room, being

a brazier; so is the Turkish *tandoor*. How long the system of placing the fire-place in the centre of the hall continued in England is uncertain; the *FEMERELL* at Hampton Court and elsewhere may be merely a relic of an old custom; but as soon as the fire was placed against a wall, the fire-place consisted, as a forge does at present, of a hearth and back, with a hood upon a mantle, tassels, and corbels: to these in time was added the CHIMNEY CORNER. But as this corner and the hood projected too much into the room, recourse was had to the fire-place, placed in a deep niche in the wall, which had been practised more or less from the tenth century, at least in England. This recess still had a hood, for the fire burnt upon a hearth six, seven, or eight feet below the mantle; and there was room enough on each side for a seat between the brandiron, etc., and the jambs. Upon the suppression of the hood (the disuse of the CHIMNEY MANTLE only dates from the Metropolitan Building Acts) the enclosed fire-place of modern times assumed somewhat of its present form but with a simplicity which it now appears desirable to regain. For the last three centuries, at least, the fire-place in an apartment has consisted, like those at Crosby hall, of an opening, under the CHIMNEY ARCH or CHIMNEY BAR carrying the CHIMNEY BREAST, enclosed by the CHIMNEY JAMBS, which connect it with the CHIMNEY BACK, roofed with a gathering (CHIMNEY HOPPER, CHIMNEY WING) having an opening (CHIMNEY THROAT, CHIMNEY WAIST) into the flue, and floored with a HEARTH SLAB, which custom has divided into front back hearths, although the former slab, when separate, is now outside the fire-place. The opening itself is decorated with a CHIMNEY PIECE, but there seems to be a growing fashion for a return to the simply chamfered edges or sunk dressings with which alone some of the mediæval enclosed fire-places were connected with flat walls. CATHUD; COVING; FLUE; GATHERING; SLAB; TRIMMER.

FIRE PROOF BUILDING. A building is said to be fire proof when the materials of which it is constructed are incapable of transmitting fire, or are in themselves incombustible. These conditions render the use of wood of every description, in its natural state, inadmissible in a building so designed; but there are several considerations, connected with the action of heat upon the other common descriptions of building materials, which require to be taken into serious account in the erection of buildings of this nature, even though the materials referred to may not be susceptible of combustion, or of transmitting heat in such quantities as to cause conflagration in the articles near them. It is to the neglect of these considerations that the destruction of valuable property has taken place in so-called 'fire proof warehouses'; and indeed there is so strong a prejudice in the minds of the authorities of insurance companies against this particular description of structures, that it has almost passed into a proverb amongst those persons that "the most destructive fires occur precisely in fire proof buildings."

The materials usually employed in the construction of fire proof buildings are cast and wrought iron, brick, stone, slate, and concrete; which practically are incombustible. But it may happen, and indeed frequently has happened, that, when large quantities of incandescent materials are contained in the same floor or portion of a building, the heat becomes so intense as even to melt cast iron; while at a much lower degree of temperature the tenacity of wrought iron may be so materially reduced as to destroy its powers of resistance. Moreover, if the heat should become sufficiently intense to raise the temperature of iron (a most ready conductor in all its forms), it is possible that in its turn that material may raise the temperature of the substances it may be in contact with to such a degree as to cause them to burst into flame; and again, when iron is used in buildings, there is always danger of fracture from its sudden contraction if cold water should be cast upon it when heated. Iron therefore, though incombustible in the common sense of the word, is capable of transmitting fire; and at any rate, unless used with precaution, it cannot be considered to be a safe, trustworthy material for

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the construction of buildings intended to receive large quantities of combustible goods. If for particular reasons, such as for the sake of economising room, iron columns and girders must be used in structures intended to be fire proof, care should be taken to interpose between the respective bearings some efficient non-conducting material; but whatever precautions of this description may be taken, no building of great cubical capacity, in which iron has been largely used, can really be considered to be fire proof, or rather to ensure the safety of the goods stored in it from the danger of fire.

When brickwork is used for the construction of fire proof buildings, it is essential to bear in mind the fact that the ordinary descriptions of bricks are themselves liable to fuse under the action of long continued and intense heat; and that the mortars or cements in which they are bedded are also liable to be affected by that agent to such an extent as to destroy, at periods varying in proportion to the amount of soluble silica they may contain, the cohesion of the various materials. The best descriptions of fire bricks, set in fire clay, or even in Portland cement, would not be exposed to this inconvenience; but not only are they heavy and expensive, but the style of construction they admit would not be adapted to the purposes which fire proof buildings are usually required to fulfil. Of course the use of concrete, whether originally supported on wooden centres or on iron plates, would be liable to the objection of the danger arising from the decomposition or changes of the lime used in its preparation; and as even the large Yorkshire landings are liable to be injuriously affected by great heat, especially when the landings are likely to be suddenly chilled by cold water thrown upon them, it would seem almost self-evident that the first and the most important law to be observed in the construction of fire proof buildings is, "*to make the various subdivisions of such dimensions only as shall not allow them to receive quantities of combustible materials sufficient to produce, by their conflagration, any chemical changes in the walls or floors themselves.*" The most common error in the construction of fire proof buildings is, in fact, that the cubical capacity of the various buildings and even of the rooms is made too great.

Another defect in this description of structures consists in their being made without due provision for the circulation of air; because when a fire does take place in the goods stored in rooms so built, the conflagration takes place nearly under the same conditions as would prevail in a closed retort; that is to say, a species of destructive distillation goes on, and gases (often of an explosive character) are evolved. Should this actually occur, the addition of small quantities of water would merely increase the activity of the fire, by supplying a fresh source of hydrogen gas; and it therefore becomes almost as important to provide an efficient ventilation for the separate rooms of a fire proof building as it does to limit their cubical capacity.

Another simple practical observation to be made upon this subject is, that in stowing goods in a fire proof warehouse care must be taken to guard against the expansion of the goods themselves, either by their spontaneous heating or by any accidental fire in them. Latterly the walls of a cotton warehouse at Liverpool were thrown out by the expansion of the burning cotton; but it must also be borne in mind that iron and other building materials themselves will expand under the action of intense fire, and that therefore precautions must be taken to allow the various materials to expand freely.

There are many methods by which the more combustible building materials may be protected against the danger of ordinary fire, if only a free circulation of air can take place round them. For instance, woodwork may be partially protected by being coated with metal plates, so as to remove it effectually from actual contact with flame. Wood and canvas may be partially protected by covering them with a solution of one or other of the preparations that have been suggested for

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that purpose; or by a silicate of lime or of baryta, precipitated by Ransome's process, in such a manner as to close the pores of the wood. It seems, indeed, extraordinary that the latter process should not have been applied to farm buildings, to bressumers, joists, lintels, etc., in house building; for it would in all probability enable those details of the particular structures referred to to resist any ordinary fire. Of course for large warehouses such imperfect expedients cannot be resorted to, and granite, stone, brick, and iron must alone be used; observing always the precautions above stated. **FLAMMABILITY.** G. R. B.

It is as well to observe that in the case of fire proof arches, they must not only be sufficient to effect complete separation, but also strong enough to resist the shock or impact of heavy timbers and such matters falling upon them from the burning of floors or roofs above; and that in the case of fire proof strong rooms, to be secure they should be built not less than two bricks thick, to resist the heat of burning materials frequently lying on them for days together, and that for the same reason the iron doors should be double, and on no account set in stone jambs or the hinges set in blocks of stone, but simply hung to frames built firmly into brickwork. H. B. G.

The various systems adopted for making fire proof floors and roofs will be noticed under those heads.

The first fire proof house of iron is reported to have been carried out by Fairbairn in 1844; *CIVIL ENGINEER Journal*, vii, 249: a fire proof school at Oxford is given in *BUILDER Journal*, 1848, vi, 228.

Papers on fire proof construction will be found in many volumes of the *CIVIL ENGINEER*, *BUILDER*, and *BUILDING NEWS Journals*; the *Transactions* of the Royal Institute of British Architects, 1855-6; the *Transactions* of the Liverpool Architectural, etc., Society, i, 20; DUTENS, *On the Manner of Securing all sorts of Buildings from Fire*, translated from the French of D'ESPIE, 8vo., 1765; BARTHOLOMEW, *Hints relative to the Construction of F. B.*, 8vo., 1819; BEAUMONT, *Hints for Preventing Damage, etc.*, 8vo., 1835; BRAIDWOOD, *On F. B.*, 8vo., 1850; HARTLEY, *An Account of Fire Plates*, 8vo., 1785, and 2nd edit. 1834; HUTCHINSON, *New Experiments on Building Materials, in reference to their Conducting Powers, etc.*, 8vo., n. d.; *Description of Tremont House, New York, with Art of Constructing F. B.*, 4to., 1830; FOX and BARRETT, *Construction of Public Buildings*, 12mo., 1849.

FIRE STONE. Sometimes the arenaceo-argillaceous deposit of the subcretaceous formation, commonly known as the upper green sand, assumes a decidedly marked stony character, and in that state it is worked, at the present day, exclusively for the purpose of forming the cheeks or covings of fire-places, or for other positions in which it may be desired to employ a material able to resist the direct action of flame. In former times, however, the fire stone raised in the neighbourhood of London was much used for church building, for instance it was employed in the erection of S. Saviour's in Southwark, the Temple church, and Westminster Abbey; but its highly perishable nature has naturally led to its neglect for ordinary building purposes of late years. The colour of this stone is of a faint green, sometimes with small sparkling facettes, and occasionally with black spots. Blocks of between 35 and 60 ft. cube can be obtained, and the stone in its ordinary state weighs about 103 lbs. per foot cube; it is sawn by the plate saw. The planes of bedding are very distinctly marked; and the stone decays rapidly if placed in the wrong way of the bed, even if only exposed to ordinary atmospheric influences.

Fire stone owes its peculiar properties of resisting the action of fire to the large quantity of the silica it contains; and it is to be observed, also, that this silica exists in the peculiar state known as the *soluble silica*. The only authentic analysis of the beds usually worked is one made by Berthier, upon the fire stone found near Havre, and it may be taken as a fair average description of the whole of this class of materials. He states that it consisted of the following; viz.—

Silica	.	.	50	per 100
Protoxide of iron	.	.	21	"
Alumina	.	.	7	"
Potash	.	.	10	"
Water	.	.	11	"

But it may be suspected, from the absence of any notice of the presence of lime, that some error exists in the analysis.

The fire stone occurs near Beachy Head, near Folkestone, at Merstham, Godstone, and Dorking; at Farnham, Bentley, Shelburne, Petersfield, etc.; in the range of the London market. G. R. B.

A variety of this stone was formerly, but now rarely, used in joinery for rubbing away the ridges made by the cutting edges of the plane. 1.

FIRMER or SIDE FIRMER, said properly to be Former or Side Former, and sometimes written Furmer (Fr. *fermoir*). The common flat CHISEL used with a mallet, by carpenters, by which the sides of mortises, etc., are formed before they are finished by the paring chisel, the ends being cleaned by the mortise chisel. A. A.

FIRMS. An old term for a pair of principal rafters, which seems to be adopted from the Fr. *ferme*, meaning a truss: it is used in the following paragraph by MOXON, in the translation of PERRAULT's *Vitruvius Abridged*, 5th ed., 8vo., London, 1703, p. 2, "The frontons imitate the firms and girders, on which is laid the roof of the house."

FIROUZABAD in Persia, see MAMMADA.

FIR POLE. The small trunks of a fir tree from ten to sixteen feet in length, used in rustic buildings and outhouses. SCAFFOLDING. 1. 23.

FIRING. The operation of putting slips of wood upon rafters or joists that have sunk or sagged so that the battens or boards may be relaid to form a level surface, or to give a fall to the boards for the current to a flat: such work upon walls for battens is properly 'blocking', but in 1632 the Company of Carpenters in London claimed "that all furring of walls and floors" (floors) belonged to the work of the carpenters, in reply to the opinion that 'firing for wainscott' (probably misspelt in JUPP, *Historical Account*, 8vo., London, 1848, pp. 296, 301) belonged to the work of the joiners; and the principle asserted in this reply is practically the system of the present time. The correct mode of spelling this term is rather doubtful, the old method will be seen in the following quotations. CHAMBERS, *Cyclopaedia*, fol., London, 1788, says s. v. *Joist*, 'sometimes the carpenters furr their joists, as they call it; that is, they lay two rows of joists, one over the other.' The same work also copies NEVE, *Dict.*, 8vo., London, 1736, who says 'furrings or furs', are the making good of the rafter-feet in the cornice; that is, when rafters are cut with a knee, these furrings are pieces that go straight along with the rafter from the top of the knee to the cornice. Also when rafters are rotten, or sunk hollow in the middle, and pieces (cut thickest in the middle, and to point at each end) are nailed upon them to make them straight again; the putting on of those pieces is called furring the rafters; and those pieces so put on, are called furs.' BACKING.

FIRST COAT in painting. This is generally called priming: the coat is laid on immediately after the *knotting* has been done. It should be a thin coat of oil with about equal quantities of white and red lead: if on stuccoed walls, the first coat should be used hot. Dishonest tradesmen frequently use size, sometimes with whitening as the first coat, to save oil and colour; but such a mixture is properly CLEARCOLE. A. A.

FIRST COAT in plastering. A coat formed of lime and hair with a proper proportion of sand. If there are to be only two coats of PLASTERING as on brick, the work is called 'rendering'; if on lath, 'laying': and the two sorts of work are then described as *render set*, or as *lath lay and set*. If the work is floated, the first coat, if on brick, is called 'roughing-in', and is left in rough ridges by the trowel; if on lath, it is called a 'pricking-up' coat, and it is scratched across while wet with a lath to give a key for the 'floating coat'. A. A.

FIRST PIECE. A term used in Lancashire for the ridge-piece of a roof.

FIRST STONE, see **FOUNDATION STONE.**

FISCHER (HEINRICH KARL VON), sometimes called Karl von Fischer, born at Mannheim 19 September 1782, was the son of the *hofrath* Karl Joseph von Fischer, who placed him 1796 as a pupil with the *ober-baudirektor* Max von Verschaffelt. Between 1801 and 1806, besides acting as clerk of the works upon the buildings constructed by his teacher for the first von Clary and the graf von Palfy, he thrice visited Vienna for improvement at the academy in that city, where he composed a design for a new opera house there, and another for a new theatre at Munich. The former seems to have been prepared under the advice of the *hoftheater-maler* von Platzer, and when it was shewn 1803 to the minister von Montgelas at Munich, it obtained for him a commission to prepare, under arrangements settled with the *hoftheater-intendant* von Babo, another design, for the hoftheater in that city. This effort was so highly praised that its author was allowed to deposit a model of the façade in the collection of the academy at Vienna, where he was then employed by the minister von Salabert to design and erect the building afterwards occupied by Prinz Karl, and now called the *pavillon royal*, at the entrance of the 'Englischer Garten'. By the advice of his teacher, he made picturesque as well as geometrical studies during his journey 1806-8 through Bordeaux, Nîmes, St. Remy, Orange, and Florence, to Rome, in order to prepare himself fully for the post he had obtained of professor in the academy. He is said to have suggested the purchase of a collection of casts from antique fragments; and the utility of this acquisition was increased during his professorship by the addition of his studies and library; these were bought after his death by the academy. As professor he had from January 1809 to January 1820 a hundred and thirty-nine pupils, of whom F. von Gaertner has perhaps obtained most reputation. Fischer was appointed 1809 a member of the *baucorrelation*, and in that capacity had allotted to his superintendence the Maximilians-vorstadt, where he also erected 1809-10 fourteen of the dwellings in the Karolinen-platz. Amongst his other works were the mansions of the then crown prince of Bavaria; of the graf von Pappenheim; of the baron von Asbeck; and of the baron von Zentner, if these are not included in the number of those already mentioned; the façade of the Home Office (ministerial-gebäude des Innern); the Anger-kirche; the general infirmary (kranken-haus); the hall of antiquities at the academy; and the hof and national theatre in the Max-Josephs-platz, with an octastyle portico having columns 50 ft. high of a Corinthian order, 1811, opened 12 October 1818, but burnt 14 January 1823, and rebuilt the next year on the original plan of Fischer. He introduced into his buildings fewer windows, and consequently wider piers, than were usual when he began to practise at Munich, where he died 11 February 1820, having obtained the rank of *bau-rath*. ALLG. BAUZEITUNG, 1836, p. 38, which also, 1841, pl. 420-35, gave illustrations of the theatre. 14. 68.

FISCHER (REINHARD FERDINAND HEINRICH), born 1745, was a pupil of La Guepière, and erected many buildings in Hohenheim, Scharnhausen, at La Solitude, and in Stuttgart, where the military academy was his chief work; he became professor of architecture in the Hohe Karls-schule, and *hauptmann* in the last named town, where he died 1810. 68.

FISCHERS (JOHANN BERNHARD), born 1650 at Prague according to some authors, but at Vienna as stated by others, studied at Rome and became a follower of Bernini. His first work at Vienna appears to have been the erection at the Graben 1693 of the Dreifaltigkeits-säule designed by Octavian Burnacini in memory of the cessation of a pestilence. Many of his works have been so frequently assigned to his son, who finished several of them, that some difficulty has occurred in drawing up the present account. His work entitled *Entwurf einer Historischen Architektur*, fol., Vienna, 1721, Leipsic, 1725,

published as *A Plan of Civil and Historical Architecture*, by Mr. John Bernhard Fischer of Erlach, Principal Architect and Chief Surveyor of the Works to His present Imperial Majesty, by T. Lediard, fol., London, 1737, in five books, contains 22 plates of *ideas* of ancient structures, 15 of ideas of the least known Roman buildings, 15 of ideas of modern Eastern works, 21 plates of modern structures invented and some of them executed by him, and 13 of vases, etc., some professedly antique, and the rest of his design, with some backgrounds of buildings composed by him inclusive of the structure at the end of the garden belonging to prince Lichtenstein. He claimed in his life-time the whole credit of the following list of works included in the fourth part, while the rest of the book might probably be designs except where drawings by travellers had received the dress that he thought desirable. In this fourth part he gives his first design for the Venerie or hunting seat at Schönbrunn, followed by a design of the buildings commenced there 1696 (but not recognizable in the present plans of that palace) by the emperor Joseph I. while king of the Romans, who gave him the *adelstand* (in English this might be explained the rank of esquire) with the addition of the words 'von Erlach', and created him *ober-land-baumeister*, of which title LEDIARD seems to have given as above the then current equivalent. Then follows a view of the arch erected 1699 at Vienna on the marriage of that sovereign; an elevation of the winter palace in the same city for the prince Eugene of Savoy, now the mint (*munz-amts-gebäude*), where that general received 9 April 1711 the Turkish embassy; plates of the palace 1711 in the S. Ulrich Vorstadt at Vienna, for the prince Johann Leopold von Trautson, which became the quarters of the Hungarian noble body guard according to FREDDY, *Descrizione*, 8vo., Vienna, 1800, ii, 82, although NAGLER, *Neues allg. Künstler-Lexicon*, 8vo., Munich, 1837, and TSCHISCHKA, *Kunst*, etc., 8vo., Vienna, 1836, speak of the Trautson palace and the barrack as neighbours; the palace built in the old town at Prague by the graf Johann Wenceslaus von Gallas; the (university) church of the Virgin 1696-1707 at Salzburg; and the church of S. Carolus Borromæus in the Wieden at Vienna, of which, according to a medal, the first stone was laid 4 February 1716; although consecrated 28 October 1737, it was not opened until 1 May 1738; TSCHISCHKA, however, fixing 1736 for the first stone, attributes the construction from a design by Fischers to Filippo Martinelli, evidently meaning the Domenico Martinelli (who he says was born at Innsbruck) of Lucca, to whom FREDDY, ii, 28-33, attributes the design, allowing the execution to have been superintended by a Fischers, giving the reason that the building did not appear in the book under notice, whereas these four plates do actually bear the inscription 'Fischers V. E. inv.' These are followed by a design for imperial stables (*marstall* or *hof-stallung*) "now building for six hundred horses", and arranged on each side of a parallelogram intended for *carousels*, with a semi-circular gallery for spectators on one of the long sides; the entrance front towards the city was the only portion erected. The list of these engraved works is closed by a pleasure-house called Klessheim (Clesheimb on the plate, but Cresheimb in the English text) for the archbishop of Salzburg; and the tomb 1714 of the graf Johann Wenzel Wratislaw von Mitrowitz in the church of S. Jacob at Prague; with two designs for pleasure houses, and one for a fortified country house.

Besides these, it may be just to ascribe to him the wooden model, probably the pattern for the marble monument in honour of the marriage of the Virgin and S. Joseph erected 1732 in the Hohe-markt; the completion 1700 of the oval hall and of the circular church at the schloss Frain (Wranow) in the Znaimer-kreis; the Schwarzenberg summer palace and state garden in the Renn-weg 1716-26 (WEIDMANN); the Bathany palace near the Freyung (this is perhaps the Schoenborn palace No. 155 in the Renn-gasse); and the so-called Mehlgrube in the Neu-markt.

The elder Fischers died 1724, and the execution, if not the

invention, of several other buildings at Vienna may be attributed to his son JOSEPH (sometimes called JOHANN and sometimes ESAIAS which last name has been printed ERAIAH) EMANUEL FISCHERS, frequently called simply EMANUEL FISCHER, whose name appears with the date 1711 as the draughtsman of the above named plates of the Trautson palace. He travelled in England and Italy, became celebrated as what would now be called a hydraulic engineer and as the introducer of the steam engine into Germany, attained the rank of *kaiserlicher-rath*, and received 1731 the title of *Freiherr* (or as it is usually translated became baron) von Erlach. Among the buildings attributed to the father as well as the son, are the church of S. Peter at the Graben, of which according to a medal the first stone was laid 22 April 1702, and consecrated 17 May 1733 (the portico, however, dates 1756); the church of S. Carolus Borromæus so far as is warranted by the statements above given; the hof-bibliothek commenced 1723, and roofed 1726 (VON LEON, *Beschreibung*, 8vo., Vienna, 1820, p. 10; BOECKH, *Merkwürdigkeiten*, 8vo., Vienna, 1823, p. 98), but not completed till 1735 (VON MOSEL, *Geschichte*, 8vo., Vienna, 1835, p. 117), having the chief saloon 240 Austrian ft. long by 54 ft. wide; the reichs-kanzlei in the Burg-platz 1728, which has been called one of the finest buildings in Germany, but is sometimes confused with the Hof-kanzlei or Vereinigte-kanzlei (of Bohemia and Austria) in the Wipplinger-strasse that is dated by TSCHISCHKA 1754, in which year FREDDY says the building as left by Fischers was altered; it was again altered 1821: the reit-schule 1729-35 (FREDDY, i, 275; and 114, 306, 313, for other buildings), placed between these two buildings and facing the Michaels-platz, which has been held to be unequalled for its purpose in Europe; it is said to have a stone gallery, round its area, supported by forty-six pillars; this is one wing as executed of the design, since lost, for a new *burg* made by the elder Fischers: to these must be added (although TSCHISCHKA, dating it 1725, does not name the designer) the above mentioned front of the stables, which is about 1200 ft. long and is two stories in height, with accommodation for four hundred horses, and handsome rooms for the equipments and accessories; the vexation attendant upon this work is said by NAGLER to have caused the death of the elder Fischers. Many other buildings, erected in Vienna during the period above embraced, may have been designed by one of these architects; but amongst such as are known to be by a Fischers, are the Auersperg palace, finished 1733 (WEIDMANN) in the Josephs-stadt suburb; count Schoenborn's palace, numbered 155 in the Renn-gasse (this may be the Bathyan palace above named); and the schloss Schwarza in the Steinfeld near Schoenbrunn; to which a tradition adds the hof-bibliothek at Berlin, erected 1777 by the younger Boumann according to NICOLAI, *Beschreibung*, 8vo., Berlin, 1786, i, 171.

The younger Fischers is said to have died 1738, but his name appears as the designer of a *castrum doloris* or hearse engraved by Schmutzer on the occasion of the death of Charles VI, 1740. A medal was struck 1719 with a portrait of one of the Fischers on either side, and the motto 'docent et delectant'. The memoir by MILIZIA, besides describing Schoenbrunn according to the magnificent engraved design, criticizes 'la colonna cochleare nella piazza del mercato' in terms which apply less to any of the votive monuments in Vienna than to the campanili at the church of S. Carolus Borromæus. Most of the above Viennese buildings are engraved in the set of 132 plates in PFEFFEL, *Abbildungen*, from drawings by Salomon Kleiner and Joseph Emanuel Fischers, fol., Augsburg, 1724-27; and the present condition of some of them in WEIDMANN, *Neuestes Panorama*, 8vo., Vienna, 1838.

FISCO (CLAUDE ANTOINE), born 22 January 1736 at Louvain, was educated as a military engineer, but established himself at Brussels, where he became controleur and directeur of the public works, and afterwards inspecteur of public works at Louvain. He became 1794 general of engineers under the

French rule, and having occasion to visit Paris was arrested, but recovered his liberty on the fall of Robespierre: he returned to Louvain, and died 1825 at Querbs, where he had spent the last years of his life. The korenmarkt, and 1775 the place S. Michel afterwards place de la Blanchisserie, but since 1830 place des Martyrs, at Brussels, were erected under his superintendence; as well as Frascati, and the collège du Faucon, at Louvain. 101.

FISHED BEAM. This term is applied not only to a beam that bellies on the under side (and is then improperly used instead of fish-beam), but to a beam that is scarfed in a manner that is less usual in the construction of houses than of ships, except where it is used to lengthen a post: under judicious arrangement, a beam that is to serve as a tie may be less dangerous when fished than a post so treated. The two pieces that are to be fished together are placed end to end, and have short pieces placed on two opposite sides, or on all sides, the whole being then bolted together. Sometimes a fish-piece or fishing piece is applied to one side only, but in such cases SCARFING is generally desirable. Fishing was not uncommon in tie-beams of great length, as in the roof over the Long room of the custom house, London. 1.

FISH MARKET. Such an edifice differs very little from other markets except that the stalls should be of stone, slate, or better still of marble; plenty of water should be supplied, and facilities afforded for throwing it over the fish; the means for drainage, taking away offal, etc., are much the same as for a meat market, as also is the necessity for perfect ventilation. Billingsgate fish market in London, by J. B. Bunning, 1850-51, is generally considered a good example; CIVIL ENGINEER *Journal*, xv, 320; and *BUILDER Journal*, x, 1 and 9. A. A.

FISSENGEN (ULRICH VON) of Ulm, was requested 16 July 1391 by the chapter of the duomo at Milan to give them his assistance, but it was not until 1394 that he wrote to accept the invitation. Their letter to hasten his arrival is dated 12 April, and he appears to have received 15 November twenty-four florins for his journey, when he was desired to make several designs which were examined 26 December, and more solemnly by seven other architects 10 January in the next year. He requested 23 February an engagement for four years at twenty florins per month; the chapter agreed to fifteen florins for each month; negotiated as to the term; and wrote for Nicolò de' Selli to visit Milan and report upon the designs, to G. G. Visconti, who replied that the architect, one or two other artists employed on the duomo, and a deputation from the chapter, should attend him and confer with Nicolò. It was negatived in the Consiglio della Fabbrica 16 March 1395 to destroy such work already executed as would interfere with the designs made by Ulrich, who was thereon sent with G. de' Grassi and J. da Campione to Pavia, whence he returned 'colle pive nel sacco'. The chapter proposed to him 25 March to continue the great window in the middle of the church, but he declined unless allowed to alter the size and pattern; and then asked him to continue the capitals of the piers, but he gave the same answer: after saying 'che prima di consegnare i suoi disegni e le sue opere voleva andarsene pe' fatti suoi', he was told that nothing already executed should be altered. Twenty florins, as a month's pay, were given to him 28 March in order to obtain his drawings, and 13 April permission to depart was accorded to his request for it: GIULINI, *Memorie*, 4to., Milan, 1760, xi, 453-5. This architect, who is called Fillingen by CICOGNARA, *Storia*, fol., Venice, 1818, i, 224, is supposed by VON DER HAGEN, *Briefe*, 12mo., Breslau, 1818, i, 264, and by NAGLER, to be the Ulrich von Eusingen of Ulm and Strasburg. ENSINGER.

FISSILE. A mineral or a stone is said to be fissile when it can be easily broken into small portions; but the term is most generally applied to such stones as are able to be detached in parallel flakes. Some varieties of gneis are fissile, as for instance those found near Cella Nova in the province of Orense; the

trap rocks are slightly so; the slates and the schists are markedly fissile; whilst some of the sandstones of the carboniferous series, of the arenaceous beds of the Wealden formations, and the limestones near Purbeck, possess this character in a greater or lesser degree; the blue lias limestones are also at times slightly fissile. Amongst minerals, talc may be cited as the most striking illustration of the fissile condition. G. R. B.

FISTUCA. This term, wherever it occurs in *VITRUVIUS*, as iii, 3; v, 20; vii, 1 and 4; and x, 3; simply, or as a root, may be more safely translated as an instrument with which to beat down ground, pavement, or concrete, such as a punner, or even as a paviour's beetle or rammer (one is figured in *RICH, Illust. Comp. s. v.*, as taken from the column of Trajan), than as the weight used in driving a pile (the monkey of a pile-driving machine), suggested by the description given of the bridge over the Rhine by *CÆSAR, Bell. Gall.*, iv, 17.

FITNESS, see *DECOR.*

FITTINGS, see *FIXTURES.*

FITZ LOWITZ'S, or MINERAL FUSIBLE, CEMENT. A resinous cement, according to *PASLEY, Limes, etc.*, 8vo., London, 1838, p. 28, who mentions that from experiments made 1829 this material, when prepared for use by melting it in a caldron over a fire, and mixing it with twice its own weight of sand, appeared stronger than the Sheppy or Harwich cements, though the latter were used pure; but that it was then about 50 per cent. dearer than the natural cements, and would burn even in the flame of a candle. From this latter fact it may be fairly assumed that this cement would be highly oxidizable, and therefore of a very temporary nature.

FIVES COURT. A rectangular structure, sometimes covered, formed by walls on three sides (the fourth side being left open), in which the game of "Fives" is played; so called originally from a tennis ball being struck by the hand, or five fingers, protected by a thick glove which is sometimes corded to insure a harder blow; it is also called hand-tennis or palm-play

lead. The paving must be selected so as to fulfil the following conditions, viz.

1. Dark in colour, so that the white balls may be easily seen when in rapid flight.

2. Capable of enduring the weather without scaling.

3. Capable of being rubbed to a smooth face without becoming slippery.

The floor should have two steps for marks in the game, and be laid with a fall to the open end for the purpose of drainage; but, beyond the end of the court, the ground should slope in a contrary direction to prevent spent balls rolling to an inconvenient distance.

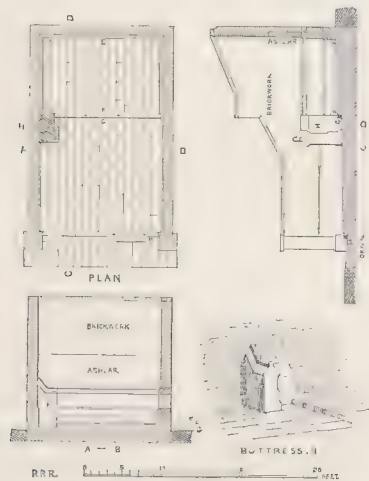
The earlier form of a fives court was a wall with wings of a small return; even a mere end wall with netting at the top, and the ground gravelled, is usual in playgrounds; the above illustration is taken from a court in use in S. John's college recreation ground at Cambridge. *Boy's Own Book*, p. 21; *Every Boy's Book*, 1860, p. 37; *STONEHENGE, Manual of British Rural Sports*, 1857, p. 501. R. R. R.

FIXTURE. This term is frequently used to signify articles of a personal nature which have been affixed to land, whether removable or not; and sometimes expressly to denote articles which are not by law removable when once attached to the freehold; but the term, in its correct legal sense, signifies such things of a personal nature as have been annexed to the realty, and which may be afterwards severed or removed by the party who annexed them, or his personal representatives, against the will of the owner of the freehold. When the article is not so removable, it is to all intents and purposes part of the freehold, and subject to the rules and incidents of real property. An 'ordynance of the Cite (of London, 1365-6) for Tenauntz of Houses what thingis they shall not remeve att theyr departinge,' is given in *ARNOLD, Chronicle*, 4to., London, 1811, p. 137.

The principle involved in the question as to what is *primâ facie* a landlord's and what is a tenant's fixture, may be briefly stated thus, viz. what is necessary for tenantable occupation belongs to the landlord, what is desirable for simply personal and individual convenience belongs to the tenant: with the increase therefore of luxury and comfort, the range of what are considered landlord's fixtures is constantly increased, and that of the tenant decreased; thus originally glass windows were *primâ facie* tenant's fixtures, now stoves and bells are *primâ facie* landlord's fixtures. H. B. G.

Fixtures are of two kinds. 1. *Trade fixtures*, those articles which a tenant fixes for the purposes of his trade or business. 2. *Domestic fixtures*, those which he fixes for domestic comfort or convenience, or for purposes of ornament. As regards the first branch, the law seems to hold that fixtures can only be removed when they are part of the trade rather than of the land, and may be carried away as more appropriate to the former than to the latter. Thus a nurseryman may remove his greenhouses, hothouses, etc., and a soap-boiler his vats and coppers; and thus a steam engine to work a colliery, a mill to make cider, sheds to manufacture bricks and tiles, are all held to be removable, though clearly affixed to the freehold. The law seems to regard them as the tools or implements necessary to a man to carry on his trade, and as things which he could remove to and use in another spot. But such things as are put up by a tenant as a means of improving the use of land rather than that of purposes of trade, are not removable. Thus, though a tenant may take away a cider mill (3 Atk., 13), he cannot remove a beast-house, tool-house, waggon-house, etc. (Elwes and Mawe, 3 East, 38.). Gardeners, etc., may remove shrubs, etc., planted for the purposes of sale, but not to pull up plants which will entail malicious injury to the reversioner, with little or no good to themselves. *GIBBONS* (p. 31) has summed up the matter with a well known legal maxim: "It is only permitted to remove such things because necessary for their trade, and 'cessante ratione cessat ipsa lex'."

With regard to the second class, *domestic fixtures*, the inci-



in contradistinction to *RACQUET*. The illustrations show the arrangement of the court, which is formed by a front wall 16 ft. high and 14 ft. wide; the side walls are 27 ft. long, and 8 ft. high at the lower or open end, sloping, or ramped up to the top of the front wall; two stone setoffs are formed at the respective heights of 1 ft. 9 ins., and 4 ft. 6 ins. from the paving, and on the left side of the players a weathered stone buttress is formed. The brickwork should be rubbed, and the masonry smoothly dressed to avoid unnecessary damage to the balls; the paving should be built upon sleeper walls, ventilated to ensure dryness, and the edges rubbed and bedded in white

dents appear to be these: 1, they must be fixed to the freehold, not slightly, like carpets nailed to a floor or mirrors fastened up by screws, but so fixed to the house as to be part thereof; 2, that they have been so fixed *by the tenant*; 3, that they be *useful* in the occupation of the house, or *ornamental* thereto; and 4, that they are capable of being removed *without* any substantial *injury* to the house. As these are questions of fact, scarcely two cases may be said to be alike, and the rights of the parties must be left to be decided more as regards the contract or agreement between landlord and tenant (either expressed or implied), and the equity of the transaction, than on dry legal maxims.

A. A.

It may be noted that besides the varieties of systems of construction that have appeared for the last century, the particular circumstances of each case as to the relation of the parties to each other, the condition of the articles in question, and the degree of injury to be caused by removal, are so regarded by the courts that few decisions, even those cited in the *ARCHITECT Journal*, 1850, ii, 122, 140, 146, and in the *BUILDER Journal*, 1849, vii, 448, and 1855, xiii, 11, can be regarded as absolute authorities for other cases, even with respect to fixtures of a similar description. The general tenor of decisions upon cases arising out of disputes as to fixtures is said to be more in favour of the tenant than of the landlord; not quite so strongly in favour of the executors of a tenant for life, or in tail, litigating against the remainder man or the reversioner; and slightly in favour of the heir against the executor of the party who annexed the fixtures. Even the period for the removal of fixtures seems to be similarly dependent in some degree upon the relation of the parties. The uncertainty above expressed should, therefore, be carefully remembered in perusing the lists of things not removable, removable though not trade fixtures, removable as trade fixtures, and doubtful, given in CHITTY, *Law of Contracts*, 8vo., London, 1857, 359; and inserted in the *PENNY CYCLOPEDIA*, s. v. in Supplement. Amongst the most recent authorities on the subject are GIBBONS, *Manual of the Law of Fixtures*, 8vo., London, 1836; GRADY, *Law of Fixtures*, 12mo., London, 1845; AMOS and FERRAR, *Treatise on the Law of Fixtures*, 2nd edit., 8vo., London, 1847; CHAMBERS and TATTERSALL, *Laws relating to Buildings*, 12mo., London, 1845.

1. 14.

FLAG, as a paving stone, see FLAG STONE.

FLAGSTAFF. The pole of a standard may not, at first, seem to be an object of consideration on the part of the architect, but as the flag and its support have been frequently and successfully applied as a means of permanent decoration, it may be useful to notice that the bronze base of one of the three such objects executed 1501-5 by Alessandro Leopardi, in the piazza di S. Marco at Venice, is given in CICOGNARA, *Storia di Scultura*, fol., Venice, 1818, ii, pl. 35; and that specimens of later treatment of the subject may be sought in the *ILLUSTRATED LONDON NEWS* among the representations of processions, etc., in Paris since 1842.

The preparation for flags shown on the propylons in the façades of temples in the *Description de l'Egypte*, Antiquités, i, pl. 5 and 6, at Philæ, and pl. 49 and 50, at Edfou, and in a bas-relief at Karnak, given iii, pl. 57, deserve notice; as well as the Roman system of fixing the poles serving as points of support to the velum of an amphitheatre, as at the Colosseum. A flagstaff on a building is one of the greatest annoyances to its architect, as unless the pole passes through the roof to a considerable distance and is treated as the kingpost of a number of trusses, it is sure to cause a continual vibration even where ropes are allowed to act as stays. The absence of such ropes is, however, almost demanded where flags are to be hoisted frequently. Another inconvenience is the difficulty of covering the hole in the roof through which the pole should pass without touching the roof itself. The flagstaff on the Victoria tower at the Houses of Parliament is a recent example of fixing a flagstaff above the roof.

FLAG STONE (Fr. *dalle*). The stone which occurs in thin and easily detached layers, and is of sufficient hardness to serve for the paving of footpaths. The flag stones used in London are obtained either from the island of Purbeck on the coast of Dorsetshire; from the carboniferous formations of Yorkshire; or from the altered argillaceous deposits of Castle Hill, or Rockhill, near Edinburgh; the stone raised from Arbroath, from the old red sandstone formations of the east of Scotland is, however, almost as good as the best Yorkshire flag.

It may be added that the Purbeck stone is objectionable on account of its irregularity of structure, and because even when it is hard there is a practical inconvenience arising from the slippery and nonabsorbent character of its surface. The Castlehill and the Rockhill flags are also objectionable on account of their nonabsorbent properties; for as they are rapid conductors of heat, they give rise to a copious condensation of vapours on their surfaces in cold, foggy weather, which vapour is likely, in its turn, to freeze in the form of a thin film of ice. It is on account of the absorbent nature of the Yorkshire and of the Arbroath stones that they are so peculiarly fitted for street paving; and in addition to this recommendation they possess the advantages of being free from the hard pins of the sulphate of iron which disfigure the Rockhill and Castlehill stones, whilst they are far more uniform in their structure, and less exposed to the danger of becoming slippery, than any other kind of stone hitherto applied for foot pavings. The thickness of the Yorkshire flags used in London at the present day varies from a full 2½ ins. to 3 ins.; the latter thickness should be used for all street pavings. Generally speaking the surfaces of the Yorkshire flags are tooled in the quarries; but they are sometimes used in the state called self-faced, or just as they are lifted from the bed; and at other times they are rubbed. All the flag stones above mentioned are sawn with the plate saw.

G. R. B.

The term flagstone, as above shown, is indifferently applied not only to laminated or thin bodied rocks—such as some limestones, and some argillaceous beds of the Silurian series—but also to a variety of sandstone in which a laminated structure prevails. A series of useful articles commenced in the *BUILDER Journal*, 1851, ix, 587, specify many localities in England from which flagstones are procured, and points out their geological position. Passing the use of granite and marble in thin slices, which can hardly be fairly noticed under this term, although marble flags are sometimes mentioned, these articles notice, ix, 605, that above the old red sandstone is ranged the carboniferous or mountain limestone, above this is the millstone grit or farewell rock, and above that the strata of the coal-measures. The first is composed in its lower part of alternations of limestone and shale, supporting a mass of nearly pure compact limestone, above which are alternations of limestone beds with grits and shales; and to this class belongs the posidonia schist in the Isle of Man from which the steps of S. Paul's cathedral, London, were supplied. The second, or millstone grit, or farewell rock, is generally composed of coarse quartzose gritstones separated by flaggy, finer-grained, and freestone grits as well as by shales, and in this division beds of chert and thin limestones are sometimes found; soft, laminated, and shaly sandstones in the Bristol coalfield support very hard beds of what may almost be termed quartz rock; (ix, 639). The third class is a series of arenaceous building-stones and flag-stones, interstratified with beds of coal, shale, and other argillaceous deposits; these arenaceous stones are usually grits of a finer grain than the millstone grits, although they all contain the same disintegrated elements of granite, the small specks or plates of mica interspersed in greater or less quantity, are supposed, chiefly, to produce the lamination or splitting tendency of the stone, because when there is little mica present the stone is a compact and solid freestone, but when the mica is abundant the stone is more or less easily split, and passes under the name of flag-stone. The localities

in England which principally produce paving sandstones are collected in p. 685 of the volume cited. The scaling and disintegration of the sandstones of the coal measures are mentioned as due to the fact of inferior stones being used, but this writer, who points out that indication of their character may be sought at the edge of paving stones, where very distinct lamination would show, is obliged to advise that the quarry should be particularly examined, and all shaky beds avoided. Stones should be refused which showed any signs of opening at the edge, or admitting the point of a knife between the layers, or exhibiting divisions of carbonaceous matter. But, while showing that some Yorkshire flagstones have yielded, while others have not, to the blistering and peeling influence of a tropical sun, the writer in question does not seem to have considered the probability that in any climate, and the certainty in a cold one, that an absorbent flagstone, used merely as coping, will not last. Every rapid alternation of the temperature of the stone seems to take off a portion of its skin.

Passing the new red sandstone formation as producing slabs rather than flags; and omitting some beds of a shaly or slaty structure, used for paving, which are found amongst the lias limestones (p. 745 contains a note worth attention), the oolitic formation is arrived at, which supplies some flagstones mentioned pp. 715, and 747. Bath, Portland, and Purbeck paving stones are noticed, pp. 747-8, the paper being confined to English materials. It is not quite clear that the lamination, of flagstone properly so called, due to conditions of deposition, is in reality different to that of slate, although this difference is sometimes advocated.

Other localities in Ireland and Scotland supply the material for flags, for which reference can be made to the several articles. The *Jurors' Reports*, 1851, 555; as well as HUNT, *Mineral Statistics*, 1860, afford much information on the subject.

FLAIRE (EI) is the only appellation by which the accounts of expenditure at the cathedral of Salamanca mention a lay brother of the Dominican order who was requested, 1522, to report upon the state of the works then being executed under Juan Gil de Hontanón; he is supposed to have been *aparejador* to Juan de Alava in the erection of the Dominican monastery and church of S. Esteban at Salamanca, 1524; and to have acted either as the *aparejador* to the same architect, or else as the architect himself, on the construction of the highly praised bridge of two arches over the river Tajo at Alvalá, between Oropesa and Trujillo. 16.

FLAKE. A local name for each of the rails passing through holes in the posts of common open fencing. This term written 'flek,' and 'fleke,' in the accounts of FINCHALE PRIORY, published by the Surtees Society, 8vo., Newcastle, 1839, cccxxv, cccxxxii, seems to mean hurdles or rails of wood used in securing the mill dam; but at p. ccccxxix, 'Scaffalides, seyntrees, and flekes,' are quoted as occurring in the contract for building the dormitory of the monks at Durham, 1401, p. 429. Fleak is used in Yorkshire for a rack suspended about 18 ins. from the ceiling, and holding the provisions of a family.

FLAKE WHITE is an oxidised carbonate of lead, which, when levigated, is called 'body-white.' It received its name from being supplied to the colourman in the form of scales or plates, sometimes grey upon the surface, formerly made in Italy by the corrosion produced upon lead by the acid of grapes, but now very largely manufactured in England by exposing sheets of milled lead to the vapour of vinegar generated by the heat of stable manure or spent tan. It is ineligible as a water-colour pigment; and is as easily altered by damp or impure air as any other form of white lead. CERUSE; CHINESE WHITE; WHITE LEAD. 9.

FLAMAEEL (. . .), see BERTHOLET-FLEMAEL (. . .).

FLAMBOYANT. This term has been adopted in English from the words *le style flamboyant* used by French archaeologists instead of the phrase *le style ogival tertiaire*, expressing that style of Pointed architecture in France corresponding in

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time to the Perpendicular, or Third Pointed work in England. The word, which literally means 'flaming, flashing, glowing, shining, or sparkling', although regarded as 'flame-shaped' by many English writers, may be considered to express the dazzling effect of the tracery which rises as a continuation of its mullions into a network of curved lines that catches the eye like the flicker, as DE CAUMONT calls it, of a brand; and was originally adopted in architectural nomenclature by Auguste Le Prévost for this style, although the *Dictionnaire de l'Académie* seems like others to apply it to French Decorated work. Although, during the existence of this phase of art, the pointed arch both acute and obtuse was used, the ogce, the broken arch, '*arc à trois sommets aigus et angles curvilignes*,' the elliptic arch, the flattened arch with a straight line for the centre portion and the semicircular arch, were all usually employed. The doorways have their jambs slightly splayed, and occupied by small moldings running from the base to the top of the arch, as in small portals of the previous style, and separating hollows in which are corbels, or pedestals, receiving small statues under rich canopies, as at the churches of S. Riquier, near Amiens, and of S. Wulfran at Abbeville. The gable over the window rises through the parapet, and is then like the parapet filled with open work exhibiting the flame, or rather, wave, feeling. A large area for the same display is provided by the practice of letting the tracery occupy a greater depth than was usual during the *style rayonnant*, in the window, which is wider in proportion to its height than in the preceding style; indeed, the tracery often has a greater height than the untracied portion. The hoodmold generally forms a very acute triangle, also filled with flamboyant tracery, and finished with a crop, and few, but large, crockets apparently imitated from the thistle, or the colewort, or the curled cabbage; but animals and monsters are not unusual as crockets. The foliage, profusely employed, chiefly consists of deeply cut masses of separate small and tightly curved leaves that have their points rather long. The wave feeling, of course, extended to every combination of moldings in suites, which generally exhibit wide hollows with fewer fillets than other small moldings between them; and the latter, unless separated by an arris, seem to melt into each other. This delicacy and intricate work are scarcely balanced in the attempt to obtain contrast by the frequent touches of deep shade in the ornament, and to exhibit vigour by sudden boldness in a colonnette, a vault-rib, or a mullion, where the important portion frequently stands out so much as to suggest that its former immediate accompaniments have been removed. The same waviness, but not the same attempt at force, is observable in the pillars; and although the bases, sometimes arranged at different levels in relation to the separate moldings, are retained, the absence of capitals or imposts is common. WILLIS, *Characteristic Interpenetrations* in the Transactions of the Royal Institute of British Architects, 4to., London, 1842, p. 81, has treated fully that portion of this style. 17.

The flamboyant style is remarkable for the thin cutting lines of its moldings alternating with deep hollows, most intricate in arrangement, but frequently exceedingly vigorous and skilfully grouped; the foliage is at once bold and delicate, and exhibits great artistic and mechanical skill. The style, however, in general is too elaborate, and is defective in outline; the surfaces are overwrought with lines, and the general composition is indistinct and confused from the multiplication of parts and delicacy of detail.

H. B. G.

The style has been also called the *style flamboyant*, or *fleur*, or *style à ogive fleur*, which last word was intended to express the profusion of ornament and multiplicity of details belonging to this period which includes the years 1400 and 1515, or in some parts of France, 1530, according to the French archaeologists, who cite S. Ouen at Rouen, S. Germain L'Auxerrois at Paris, and (completest of the three) the portal of the church at Senlis, as good examples. POYNTER, *Contemporary Styles*, in the Transactions above cited, p. 70, gives illustrations of the tour

de la Madeleine at Verneuil; and of the door of the church at S. Remi, near Dreux.

INKERSLEY, *Inquiry*, 8vo., London, 1850, considers that the period, if it dates earlier than the nave, choir, and chapels of the church at Caudebec, 1426-56, extended at least to 1540, when designs in the Flamboyant and Renaissance styles were submitted by the same architect for a portal to the church of S. Nicolas at Troyes, and even later. He gives pp. 32-7 and 114-122 the authorities and dates for several instances of the style; amongst which he indicates, as the most perfect for the purpose of study, the cathedral at Nantes; the church of S. Maclou at Rouen; and the front of the north transept of the cathedral at Evreux executed during the episcopate 1532-74 of Gabriel le Veneur. He declares that the last named work has just claims to be considered as the most perfect, beautiful, and consistent specimen of its class; and notices that at Rouen and Troyes care must be taken in separating the Flamboyant and Italianized portions, the former lingering longest in the windows. Some instances of the occurrence of work apparently flamboyant in Great Britain, will be considered *s. v.* PERPENDICULAR.

FLAMMABILITY. This term (like inflammability, which might have been reserved for the contrary) means the quality of admitting to be set on fire, or of catching fire. Timber ought never to be put near a fire place, nor any means of producing heat; for it becomes so dry that what is improperly called spontaneous combustion may occur if the wood be exposed long to a high temperature, even if that does not exceed the heat of boiling water. Eight or ten years are said to be sufficient for a pipe charged with hot water, steam, or hot air to produce this high degree of flammability upon its wood casing. The Metropolitan Building Act, 1855, requires that no pipe for conveying heated air or steam be fixed nearer than six inches to any combustible material; that no pipe for conveying hot water be placed nearer than three inches to any combustible material; and that no pipe for conveying smoke or other products of combustion be fixed nearer than nine inches to any combustible material.

A composition to resist fire for five hours is given in *BUILDER Journal*, xvii, 399; and another for an hour and a quarter only, p. 477. Burnett's patent applied in sufficient strength to wood renders it unflammable. A compound proposed by Dr. Hancock is detailed in the *CIVIL ENGINEER Journal*, 1838, i, 373. Many other modes have been suggested of rendering substances less combustible by saturating them with some solution; such as sulphate of ammonia, and tungstate of soda, for muslin, lace, etc. ANTIPYRETIC; FIRE-PROOF BUILDINGS; WATER GLASS.

FLANDERS BLUE (Fr. *cendres vertes*), very apt to turn green, was a colour formerly much used, and was probably a verditer prepared by an alkali from sulphate of copper.

FLANGE. (Fr. *Flanche*). The name given to a plate projecting from the side or end of a piece of wrought or cast metal. Thus the short arm of an L bearer is the flange; in Y shaped material two flanges are recognised, as ought to be the case in the I section where, however, it is usual to speak of the two flanges as the top or bottom flange, although this is more generally said rather in reference to cast iron than to rolled metal, where the double flange of T iron is simply called a table. Castings are frequently secured to each other by bolts passing through the flange of each piece; a composition of white and red lead, or of tar and gasket, being put between the two surfaces. In works intended to stand great pressure, *iron cement*, a composition of iron filings and sal ammoniac, is often used. Wrought iron is sometimes similarly secured; and a fictitious flange is frequently obtained by the use of rivetted ANGLE IRON.

FLANK. The return or side surface, extending from the front to the rear of a building. The return or wing walls of a bridge are, however, sometimes called flank walls; and the portion on each side, between the springers and the crown of an arch, is called one of the flanks or haunches.

FLANK OF A ROOF. A term used in Scotland for the valley. FLANK TREE. A valley rafter. LONDON, *Encyc. of Cottage, etc., Architecture*, 8vo., London, 1839, § 1102.

FLANNING. A local term for the internal splay of a window jamb; RAINE, *History of North Durham*.

FLAP. This term, originally applied to any thing broad that was also pendent (such as the shutter which hung from the bressumer, or from the stall board piece, so as to serve in one case as a penthouse roof, and in the other for a showboard, or a table), has remained in use for each division of a shutter that has leaves hinged to the first one, and to each other successively so as to be concealed when the whole are folded up in the boxings; the concealed leaves being respectively the first, second, etc., back flap, counting from the visible front flap. A trap-door is sometimes called a flap, but a distinction is still observed between the flaps of a folding trap-door, and the leaves of a folding door. So also a window having its shutters in two pieces hung on each jamb is sometimes said to have two flaps, but properly two leaves.

The term is also used for the self-acting cover to the outlet of a drain or sewer, to prevent the influx of water.

FLASHING. The process of making glass into circular tables or sheets, as for crown glass. The term 'flushed glass', as meaning glass with colour on one surface only, is not noticed by WINSTON, *Inquiry*, 8vo., Oxford, 1847, who calls such glass covered or coated glass. All tints of stained glass (except red, which is almost invariably coated) are generally of POT-METAL, but are not unfrequently coated.

FLASHING. A piece of thin lead placed over that part of a gutter which turns up against walls, parapets, etc., to prevent the dash, flush, or splash, of the rain getting between them. It is, sometimes, merely attached to the parapets by wall hooks, but this is by no means a good way; against brickwork it should be turned into the joints, at least an inch; and in stone work be turned into a groove cut into the stone, and be secured by cement, or be burnt-in, as it is called, with cuttings of lead and a hot iron. 'Step-flashing' is similar lead work covering the slating, and going up the rake of the gables of a building, being used in lieu of lime and hair filleting; and is so called because it is turned into the brick work in steps. FILLETING. A. A.

FLASK. A term used by ironfounders to express the iron or wood frame intended to receive the sand which forms the upper or the movable part of the mould, into which the molten iron is to be poured from the cupola. The shape of a flask naturally depends on the shape of the casting it is intended to produce.

FLAT. A term applied to each floor of a building specially adapted for dwellings, where all the accommodation required for a single person, or for a family, can be obtained without either ascending or descending to another floor. In Edinburgh and some other parts of Scotland this custom has prevailed; and most of the houses in Paris are so built: the system has of late years also been adopted in England for Model Lodging Houses; as well as for residences of a higher class, as in Victoria-street, Westminster, likewise built fireproof, which are given in *BUILDER Journal*, 1855, xi, 721. Details of a modern Parisian house are given in the *BUILDING CHRONICLE Journal*, 1857; most modern works on French architecture are replete with similar examples of greater or less extent.

FLAT. This term, as the abbreviation of 'flat roof,' is applied to any covering which has but a slight fall to its eaves or gutter. Such a flat is generally formed with a rough flooring laid in the direction of the current, rarely less than 1½ in. thick, laid on joists to receive a lead or copper or zinc covering. The flat so formed must have a proper FALL or current to a sunk gutter, and be made with rolls to turn the lead over; these rolls should be only so wide apart as to receive lead of half the width of the sheets as usually rolled, or the lead will be liable to 'draw' with the heat of the sun, and to crack. If the boards are not properly jointed for lead, they should be roughly adzed

down to a thickness, or the edges will be liable to cut the lead when much trodden upon.

A. A.

Similar preparation is made to receive copper which is laid with folds instead of rolls. Zinc sheets covering flats which have little fall may be soldered; but long lengths in this, as in the other materials, should have drips: fillets with chamfered edges are better, than rolls, for zinc; in Belgium they are chamfered so as to be narrower on the underside, thus giving more play for the sheets: and the boarding should be of dry fir secured with zinc nails, or with iron nails having small heads to be driven well into the wood and covered with cement or stopping. Other materials and modes of forming flat roofs will be noticed under TERRACE ROOF.

FLAT ARCH, in brickwork and tiles, is noticed under BRICK ARCH; FLOOR, FIREPROOF; ARCHITRAVE.

GELL, *Top. of Rome*, 8vo., London, 1834, notices the flat entrance arch of seven voussours, illustrated by S. SMIRKE, R.A., in the *ARCHÆOLOGIA*, 1838, xxvii, 383, occurring in the tunnel, or emissarium, from the lago di Albano or di Castello in Italy. One of the largest flat arches still existing is the so-called 'stone beam', 30 ft. span, between the western towers of Lincoln cathedral, given in the *Transactions* of the Royal Institute of British Architects, 8vo., London, 1842, p. 180. Such arches are also seen in the chimney-pieces of the mediæval period; and in some architraves of porticoes and colonnades, as illustrated in French publications of the eighteenth century.

FLAT NAIL. The term given to the nails used by hurdle makers and coopers.

R. R. R.

"Flat pointed nails are of two sorts; the longer are used in shipping, and are very proper to hold where you cannot clench; the shorter are fortified with points to drive into oak, and are used to draw sheathing boards to, etc." HARRIS, *Lex. Tech.*, ii, fol., London, 1710.

FLATTING COAT. A coat of oil paint which, when laid, does not present a glossy surface. This appearance, being only desired for interior work of the best apartments, is due to the introduction of a considerable quantity of turpentine instead of oil into the material. A half flattening coat, containing much less turpentine, is sometimes laid as a preparation, and is commonly called DEAD COLOUR.

FLAT-TINT. This term is used in speaking of a painting in water-colours, to denote a quantity of any colour spread evenly over any relatively large portion of the paper, or other material upon which the picture is made. As some pigments, like cobalt, will not mix so thoroughly with water as to allow an even wash of them to be laid on the paper, recourse is sometimes had to the practice of stippling the first wash, and thus arose the absurd phrase—a stippled flat tint. ROBINSON, *A Collection of Examples of Coloured Ornament, to serve as first exercises in Flat Tinting, prepared for the use of Schools*, 4to., London, 1853.

FLAWING. The term used in the South of England for stripping the bark from oak trees when felled in spring. Although winter-felled oak is much superior, as has been shewn *s. v.* FELLING, the value of oak bark is so great as to induce the major part of growers to fall in spring, when the bark is full of sap and in condition for tanning, which it is not at any other season. The term may be a corruption of 'flaying'.

A. A.

FLAWING IRON. A sort of large chisel with which the oak bark is stripped off when the trees are felled in spring, instead of in winter.

A. A.

FLEAK, see FLAKE.

FLEMAEL, see BERTHOLET-FLEMAEL (. . .).

FLEMISH ARCHITECTURE. About the latter period of the portion of European history comprised under the term 'the Middle Ages', the architects and artists, of the provinces under the rule of the counts of Flanders, the dukes of Brabant, and the dukes of Burgundy, exercised so very marked an influence upon the outward expression of the arts, as to render it more than usually important to endeavour to ascertain the

nature and conditions of that influence, as well as the history of the development of the Flemish school.

The Flemish race may ethnographically be considered to have originally comprehended the inhabitants of the district which formed the kingdom of Austrasia upon the subdivision of the Carolingian empire, and at one time to have been merged in the general family of the Niederduytsch. Upon the establishment of the feudal system, Austrasia in its turn was subdivided into a series of independent fiefs, and the districts, subsequently known under the special name of the Flemish provinces, were possessed respectively by the counts of Boulogne, Artois, Flanders, and Holland, the duke of Brabant, and the bishops of Utrecht and of Liège; an arrangement inevitable from the necessity of providing for the defence of the country from the incursions of the Norman pirates, and of the still barbarous and idolatrous Saxons and Friesian tribes of the country beyond the Ems. The Normans seem even to have made permanent settlements upon the coasts; and the Frisians, between the lake Flevo (which occupied the position of the inner portion of the present Zuyder Zee) and the Ems, were at a comparatively early period brought into something like an organized state of society by the efforts of the bishops of Utrecht, and of their superiors, the archbishops of Cologne. At the same time the remains of the Kelto-Roman tribes, who had maintained a species of semi-independence of the German invaders of the West (by reason of the strategical advantages offered to them by the naturally defensive strength of the forest of Ardennes), succeeded in uniting themselves into a distinct nationality, under the name of *Walloons*, which existed until the absorption of the whole of the provinces thus enumerated into the dominions of the dukes of Burgundy. These dukes were members of a younger branch of the royal family of France, who succeeded by intrigue, force of arms, treachery, and fortunate marriages, in raising their insignificant appanage to the importance of a feudal dependence of France equal, if not superior, to the power of their suzerains. Philippe le Bon was the first member of the family who united the various provinces of the Niederduytsch to the duchy of Burgundy and the Franche Comté; for in September 1419 he succeeded to the county of Flanders by right of inheritance from his mother, Marguerite de Mâle; in 1429, he obtained the county of Namur; in 1430, the duchy of Brabant; in 1436, the county of Hainault; in 1451, the duchies of Limburg and Luxemburg; while the counties of Holland, Zeeland, and the districts of East and West Friesland having passed under the authority of the counts of Hainault about 1345, were transmitted to the dukes of Burgundy with the other possessions of that family.

This very summary sketch was required to explain the fact that, at one period of the Middle Ages, a peculiar style of architecture, which may almost be called national, prevailed over the whole area bounded on the south and east by the Somme, the head waters of the Oise, the Meuse, part of the Moselle, and the valleys of the Rhine and the Ems; and on the north and west by the German Ocean. This style was a local modification of debased Roman architecture, or pseudo-Byzantine style (called by German archaeologists the *Rundbogenstyl*); and some very remarkable specimens of its earliest and purest forms are to be found in the monuments near Aix-la-Chapelle and Nimeguen, which are attributed to Charlemagne, and are certainly of the very earliest period of the Carolingian dynasty; that is to say, they date from about the end of the eighth or the beginning of the ninth century. From the ninth to the eleventh century, the confusion and utter disruption of all social organization, in consequence of the incursions of the Normans and of the overthrow of the Carolingian empire, was so universal in the north-west of Europe, that few permanent monuments of the period have survived. At Maestricht, Buremonde, and Liège, there are, however, some interesting remains of the ninth and tenth centuries; and at Soignies, Bruges, S.-Denis-Westrem, Nivelles,

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Alne, Echternach, Tongres, Sluis, and Bruxelles, there are to be found other specimens of the arts of building as practised in this dreadful period. The cathedral at Tournai, the cloisters and other details of S. Bavon at Gand, and the churches called Notre Dame de la Chapelle at Bruxelles, and S. Vincent at Soignies, are the most important ecclesiastical buildings of the Niederduytisch family in the round arched style; and they present some trifling peculiarities in the mode of treatment adopted in their details which may merit observation. Thus, the capitals and bases of the columns are plainer and ruder in the Austrasian provinces than were the analogous portions of the buildings of the same epoch erected in the interior of France, in England, or in Westphalia. The Austrasian arches are not ornamented with the billet, the zigzag, the dog's tooth, or the chequers of the more elaborate style of the other countries noticed; and generally the treatment of the details is of the coarsest description, and without any attempt to express ideal beauty. In this respect there is a marked difference between the architecture of Austrasia, and of Westphalia where the *Rundbogenstyl* was characterized by great elegance, and even by lightness of design; perhaps this difference may have arisen from the fact of the lower state of civilization in the former province, consequent upon the continual incursions of the Norman pirates.

Upon the decline of the Carolingian dynasty the political organization of Western Europe became entirely changed, and the introduction of the feudal system gave rise to the formation of subordinate nationalities, some of which have survived even to the present day; as, for instance, those of Belgium and Holland. The precise origin of the former of these nationalities, which has to the architect and the artist the interest attaching to the production of a distinct school of art, is first recognized in the creation of the county of Flanders under Baudouin Bras-de-Fer, about the year 862. Baudouin built the forts of Bruges and Gand; his son built the walls of Ypres and Bruges, the fortifications of S. Omer, and the town of Berg (near Tongres). About 964 the counties of Boulogne, Guines, and Saint Pol were partially detached from the suzerainty of the counts of Flanders; and about 1186 the counties of the Vermandois and of the Artois were seized by the king of France, thus reducing the dominions of the counts of Flanders to the comparatively narrow limits of the provinces held under the crown of France; for the dukes of Brabant had succeeded in securing for themselves the provinces of Zeeland and of Imperial Flanders. About this period also the popular distinction between *la Flandre flamingante* and the *Leliaerts* (or between the Flemings who clung to their own nationality, on the one hand, and the partisans of the fusion of that nationality with the gradually encroaching one of France, on the other) began to assume a marked character. *La Flandre flamingante* comprised the country which at present forms the provinces of East and West Flanders, and part of the French department Du Nord; and it was precisely within its limits that the municipal organization of the Low Countries began to develop itself the most successfully, and that the school of architecture and art which ought exclusively to bear the name of *Flemish* arose. This school eventually extended its influence to the other provinces of the Niederduytisch race; but its most characteristic productions will be found in the towns of Flanders, properly so called, or in Gand, Bruges, Ypres, Audenaerde, Courtrai, etc., from whence the Brabançons, the Liègeois, the Dutch, and even the Spaniards of the beginning of the sixteenth century, derived their models. It is important, however, to observe that the political events, which thus gave rise to the Flemish school, coincided with the period of transition from the round arched or romanesque style, to the pointed or ogival style; and that the architecture of Flanders from that period forward retained its local characteristics until the commencement of the seventeenth century. Before these events occurred, the architecture of Flanders did not materially differ from that of other parts of Europe; after them it became distinctly national and peculiar.

During the period in which pure mediæval architecture prevailed in north-western Europe, that is to say from the twelfth to the end of the fifteenth century, Flemish buildings of an ecclesiastical character were very similar in their details and in their general effects to those erected in the French and Norman provinces north of the Loire. The transition from the round arch to the ogive, and the successive stages of development of ogival architecture, were moreover so analogous to the similar changes observed in England, that Mr. W. H. Weale (the author of the best Guide-book to Belgium) has not hesitated to apply the terms First, Second, and Third Pointed to the Belgian churches in which they occur. The only important remark to be made on this subject is, that the progress of architectural change seems to have been in Belgium, chronologically, rather in advance as compared with England, but rather behind the progress of change in France. There is a poverty of outline, and a deficiency of chiaroscuro, in the pure mediæval architecture of Flanders; the moldings are not deep, nor is the foliage of a rich picturesque character, whilst the tracery is often awkward and thin. Instances of these defects are to be found in Ste. Gudule at Bruxelles, begun 1170-1518; S. Jacques and Ste. Marie Madeleine at Tournai, both principally of the thirteenth century; the church of the Sablon at Bruxelles, 1304-1513; S. Martin at Ypres, 1221-1434; the Graven's kapelle at Courtrai, 1238-1373; the churches of Notre Dame, 1055-1499, and of S. Denis, 1152-1450, at Saint Omer; S. Sauveur, 1186-1526, and Notre Dame, 1119-1520, at Bruges; S. Bavon, 1228-1534, and S. Jacques, 1130-1450, at Gand; Notre Dame at Dendermonde, 1388; S. Jacques at Liège, 1016-1538; S. Leonard at Leuven, 1241-1519; and the churches at Antwerp, 1352-1500; Lierre, 1453-56; Aerschot, 1331-37; Malines, 1180-1538; Nivelles, the end of eleventh century; Villers, 1197-1480; and Huy, 1311 to the sixteenth century. As a general rule, also, Flemish churches want elevation, and there is rather a tendency on the part of their architects to develop in their designs the horizontal at the expense of the vertical character, so distinctly marked in the best French examples of the mediæval periods. In the civil architecture of this phase of art the defects alluded to do not assume so prominent a position; because, in the first place, the purposes to which the buildings are devoted render necessary and explain the horizontal character of some of their elevations; and, in the second place, because the genius of the Flemish architects seems to have turned itself with especial zeal to the endeavour to meet the requirements of the peculiar political organization of their country. The various town halls, the belfries, hospitals, and private houses of the Flemish towns are, in fact, the most important and the most characteristic monuments of this school. Thus the ancient town hall at Alost, begun 1210, finished 1465; the town hall at Ypres, 1201-1342, and the *boucherie* of the same town, thirteenth to fifteenth century; the belfry at Tournai, 1187-1391; the *halles*, 1291, and the town hall at Bruges, 1377; the town hall at Damme, 1242; the belfry at Gand, 1377; that at Lierre, 1367-1413; the *porte de hal* at Bruxelles, 1379; the *halle aux draps* at Gand, 1424, and the town hall of the same city, 1481, may be referred to as illustrations of this particular class of structures during the mediæval period of the ogival architecture; and they are perhaps the more worthy of remark from the fact that, in the earlier ages of Flemish history, no civil structures of any importance were erected, and that the buildings just named are contemporaneous with the establishment of communal liberties in the Low Countries.

It was, however, in and subsequent to the fifteenth century that the Flemish schools, both of architects and artists, assumed their distinctly marked national character; and it was shortly after the commencement of the former century that nearly all the important municipal buildings of Flanders were undertaken, notwithstanding that the continually increasing power of the dukes of Burgundy curbed the liberties and diminished the

importance of the communes in a very serious manner at this precise period. The town hall at Bruxelles was begun by the architect Jan von Ruysbroeck in 1401 or 1402, and the first stone of the west wing was laid by the comte de Charolais, afterwards Charles the Bold (the violent repressor of communal liberties), in 1444. The town hall at Louvain, commenced in 1448 by Mathieu de Layens, was completed in 1463; it is unquestionably the finest municipal building erected under the influence of the Flemish school. The town hall at Mons was built about 1458; that at Gand between 1481 and 1580; that at Audenaerde, commenced upon the plans of Henri van Pede in 1527, was finished in 1530; the town hall at Courtrai was commenced in 1526; the town hall at Leau was built about the same time; the picturesque houses on the Grande Place at Bruxelles, and the maison des Bateliers at Gand, were of the commencement of the sixteenth century; the palais de justice at Bruges was built about 1538; the bourse at Antwerp, about 1581; the palais de justice at Liège, about 1508 to 1539; and the *grand conseil* at Malines, commenced in 1530, by Rombaut Kelderman. In all these buildings the decay of pure mediæval spirit may be distinctly traced, and the architecture passed rapidly through the phases of the Decorated, highly Decorated, and Flamboyant, to the Renaissance, which began to exhibit itself in Flanders, as in the town hall at Antwerp, about 1561 to 1665. There is great pictorial effect in almost all the town halls above named, as well as in those of Arras, Saint Quentin, and Noyon, erected by architects educated in the Flemish school; but the ornamentation in a manner overlies the design, and attention is drawn from the general effect to the exquisite beauty of the details. In some cases the beauty of separate features of these structures is such that they are even more generally known than the buildings containing them; thus the portail de la salle des Echevins, carved by Paul van der Schilden, in the town hall at Audenaerde; the two chimneypieces in that at Courtrai; and the chimneypiece of the *palais de justice* at Bruges, may all be cited as illustrations of this remark.

In ecclesiastical structures of the Flemish architects of this period, that is, of the short but brilliant reign of the dukes of Burgundy, from the beginning of the fifteenth to the middle of the sixteenth century, the same observations hold as in the case of the municipal structures above mentioned. In the churches at Hazebrouck, 1490 to 1520; at Alost, 1438; the west tower of S. Bertin at Saint Omer, 1431-99; S. Waudru at Mons, rebuilt by de Layens in 1450; the towers of S. Gudule at Bruxelles, 1518; the tower of S. Martin's cathedral at Ypres, built by Utenhove of Malines about 1434; the tower, nave, and transept of S. Bavon at Gand, 1461-1534; the tower and the greater portion of the body of S. Rombaut's cathedral at Malines, 1400-1538; the church of S. Jacques at Antwerp, 1404-1694; S. Jacques at Liège, 1513-38; and S. Gertrude at Louvain, 1514-60; in all these buildings the same law of architectural development, through the Decorated, highly Decorated, and Flamboyant styles, already mentioned, may be traced. As said of the municipal structures of this period, there is a marked tendency in the architects of the ecclesiastical edifices to fritter the general effect, and to overload the designs with ornaments of questionable taste, in so far as it attracts attention from the mass to the details. In many cases, again, the adjuncts of the churches erected by the Flemish architects of the fifteenth and sixteenth centuries have been treated with such marvellous luxuriance, and perhaps even with such a keen perception of beauty, as to cause the buildings themselves to be almost forgotten. Thus the rood screens of S. Gommaire at Lierre, and of the church at Dixmude, the altar of S. Waudru at Mons, the *chasse* of Ste. Ursule at Bruges, by Hemeling, the tabernacle of the church of S. Peter at Louvain, etc., are even more generally known than the churches themselves in which these exquisite details are to be found. In the church of S. Martin at Liège, finished by Paul Rickel in 1542, the interior is treated

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in the bold, lofty, and at the same time harmonious, manner which characterized the best periods of the ogival style; but in the majority of the ecclesiastical contemporaneous buildings the tendency already noticed to substitute the horizontal for the vertical line, may be distinctly traced; for instance, in the interior of the abbey of S. Hubert in the pays de Liège; and in the very striking façade of the chapelle du S. Sang at Bruges. It would seem, indeed, as though the brilliance and the power of the Burgundian dynasty had as distinctly influenced the mode of expression in architecture as applied to religious, as it had done in the case of civil, buildings; and that the influence in both cases—whether for good or for evil—had facilitated the transition from the mediæval spirit to that of the Renaissance.

During the reign of the Burgundian family, and of the first princes of the house of Austria, who succeeded to their dominions (a period, in fact, nearly contemporaneous with the period between 1400 and 1560), Flemish architects and artists were much employed in the other provinces of their ruler's dominions; and in the various highly Decorated and Flamboyant buildings of Burgundy, Franche Comté, and Spain, the influence of the Flemish school may be easily recognized. In the cathedral of Dijon; in some of the buildings at Beaune; in the church of Notre Dame de Brou; in the cathedrals of Burgos, Seville, and Toledo, it is known that Flemish architects were employed. After 1560, however, Flemish architects seem to have subsided into obscurity, or at any rate they adopted so unreservedly the principles of design which were in fashion in Spain, Austria, and France, that the national character of Flemish architecture, from that period forward, was lost. For many years the heavy, over-decorated, style so generally adopted by the Jesuits of the seventeenth century, prevailed in Flanders and the rest of the Low Countries; as may be observed in the church of S. Carlo Borromeo at Antwerp, and in the other churches of that order to be found in Belgium. In civil structures the Spanish style prevailed, of which illustrations may be found in the town halls at Lille and at Valenciennes (then Spanish), and in many of the private houses of the Flemish towns, as well as in the gates or military buildings erected between the middle of the sixteenth and the end of the seventeenth centuries. In the eighteenth century Flemish architects contented themselves with adopting a pale reflex of the style of their French neighbours; and though, as in the case of the legislative palace at Bruxelles, begun by Guymard in 1799, some of the public buildings of this period were marked by considerable talent, they are all deficient in originality and in national character. During the French occupation of the Belgian provinces, of course no attempt was made to develop any form of indigenous art in the latter; nor under the rule of the house of Orange was any progress made in that direction. Since the independence of Belgium a certain amount of activity has prevailed, both in the construction of new and in the restoration of old buildings; but unfortunately the taste hitherto displayed, in both those classes of operations, by the Belgian architects, has been worse than equivocal. It may, however, be worthy of remark that the buildings erected in Flanders proper partake greatly of the character of the Spanish school of the seventeenth century; whilst those erected in the Brabant, Liège, and Namur districts, are more allied to the French and German schools.

The remarkable school of sculptors who, in the seventeenth and eighteenth centuries, produced those pulpits, confessionals, fonts, and tabernacles, to be seen in the Belgian churches, must be noticed. Amongst these were Quellen, van der Meulen, the du Quesnoys, Pepers, Delcourt, Delvaux, Hedelbourg, de Vriendt, de Heere, Abcets, Verbruggen, etc.; and they certainly have treated marble and wood with a freedom and a degree of grace and elegance hitherto unrivalled. There is, however, a singular absence of propriety or consistency in the taste or style adopted in these details; so that, however beautiful they may be in themselves, they always look incongruous.

There is some remarkable painted glass in the Flemish cathedrals, but none of sufficient importance for special notice.

SANDERUS, *Chorographia Sacra Brabantiae*, fol., Hague, 1726; *Flandria Illustrata*, fol., Colonia, 1641-44, or Hague, 1735; MARTENE et DURAND, *Voyage Littéraire de deux Benedictins*, 4to., Paris, 1717; LEEMANS, *Romische Ouderheden te Maestricht*; DE BAST, *Recueil d'Antiquités Romaines et Gauloises*, 4to., Gand, 1808; SCHAEFFKENS, *Tresors de l'Art en Belgique*, 8vo., Bruxelles, 1848; SCHMIDT, *Manuel de l'Architecture, des Monumens Religieux*; DEVIGNE, *Mémoire sur l'Architecture en Belgique*; DUMORTIER, *La Cathédral de Tournai*; STAFFAERTS and STROOBANT, *Monumens d'Architecture et de Sculpture en Belgique*, fol., 1854-5; MÖCKE, *La Belgique Monumentale*, 8vo. [7 1846]; LE MOYEN AGE PITTORESQUE, fol., Paris, 1837-40; LE MOYEN AGE MONUMENTALE ET ARCHÉOLOGIQUE, fol., Paris, 1840-44; SCHAYES, *Histoire de l'Architecture en Belgique*, 2nd edit., 12mo., Bruxelles, 1853; W. H. WEALE, *Handbook for Belgium*, 12mo., London and Paris, 1859; HAGHE, *Sketches in Belgium and Germany*, fol., London, 1840-50; WILD, *Architectural Grandeur of Belgium*, etc., fol., 1833; CONEX, *Beauties of Continental Architecture*, etc., fol., 1831-3; PROUT, *Sketches in Flanders*, etc., fol., 1833; CHANTRELL, *On the Domestic Buildings of Western Flanders in the Sixteenth Century*, illustrating the Ornamental Brickwork of that Period, given in the *Transactions of the Royal Institute of British Architects*, 1855-6, 143: the original MS. with its illustrations are placed in the library of that society. G. R. B.

Besides this notice of the styles adopted within the boundary of its own and neighbouring provinces, mention may here be made that the Flemings early obtained a footing in England, as around Coniston hall in Cumberland, in the reign of William the Conqueror; in those of William II and Henry I, 1087-1135, emigrants settled in the waste lands of Northumberland and Cumberland, where their language may still be traced in the names of places. Some were compelled by the later monarch to relinquish their English settlements and to fix themselves in Wales, as noted by NORRIS, *Etchings of Tenby in the County of Pembroke*; including many ancient edifices which have been destroyed; and intended to illustrate the most striking peculiarities of early Flemish Architecture; with a short account of that town and of the principal buildings in its neighbourhood, 40 pl., 4to., London, 1812. Others are stated to have been banished by Henry II, when they consequently repaired to Scotland, where they settled, and in the thirteenth century became possessed of nearly all the trade of that country, even obtaining the right to be governed by their own laws; JEFFREY, *Roxburghshire*, 12mo., London, 1857, iii, 105. Little Wenham hall, Suffolk, erected about 1260 or 1280, is generally noticed as an early instance of the use of bricks in England, and as it contains bricks of the modern so-called Flemish shape, it has been quoted as a work of the Flemings; TURNER, *Dom. Arch.*, 8vo., London, 1851, besides illustrating it, 151, states, p. 125, that in the thirteenth century the Flemings and Italians engrossed the most lucrative departments of English commerce; both purchased our staple commodity, wool, and both introduced, and by nearly the same route, the Low Countries, the products of the more skilled artisans of the South of Europe, and the rarer merchandise of the East. Winchester in the same century had 'the street of the Flemings'. In the middle of the fourteenth century, the policy of Edward III induced the Flemings to settle in this country, and Cranbrook in Kent is recorded as the centre of the cloth trade introduced by them; the arts followed, stained glass, brasses, screens, and other works, as for instance the tomb of Philippa, wife of Edward III, in Westminster Abbey, were imported from that country, or executed by artists therefrom. At a later period, as in the reign of Henry VIII, a similar influence was felt, by the introduction of Holbein, 1526, and other Flemish and German artists, who assisted to carry out and to modify the Elizabethan style of architecture. Workmen from Flanders

were established in 1543 at Barcheston, Warwickshire, to commence a tapestry manufactory. The first Royal Exchange in London was erected 1566-8 by Sir T. Gresham, who "bought the stones in Flanders wherewith he paved the Burse. But as he will answer peradventure, that he bargained for the whole mould and substance of his workmanship in Flanders"; HOLINSHED, *Chronicle*, fol., 1586, i, 235. Some peculiarities in the woodwork of the dwellings in the ports of the east coast of England have been attributed to the residence of foreign carvers, or to an imitation of their works in foreign vessels; and many traces of Dutch or Flemish occupants might be observed in the fenny parts of East Lincolnshire.

From the year 1500 to 1660 or thereabouts, Scotland adopted the sterner features of the French and Flemish residences, and so cleverly mingled their peculiarities with the castellated architecture of her own growth, as to produce a Baronial style peculiar to the country; BILLINGS, *Baronial Antiq.*, introd. vii, 4to., London, 1848-52. AUBREY, *Sturley*, 8vo., London, 1717-9, iii, 209, describing Frimly chapel, says it is of the Flemish manner of building, that is, a mixture of timber and brick. But a still more Flemish or rather Dutch character accompanied the favourites of William III, on his accession to the throne, exemplified at the new portion of Hampton Court palace designed by Sir C. Wren, 1690, and in Marlborough house, London, etc., being also continued by other architects of that period. The influence subsiding here much in the same way as it did in its country as above developed.

FLEMISH BOND. Brickwork so arranged that the bricks in every course present the appearance of a header and a stretcher, alternately, from one end to the other; and in successive courses every header is placed over the centre of a stretcher in the course below it; closers being put next to the corner headers in alternate courses. In walls 9 ins. thick both sides of the wall are necessarily alike; but in walls of greater thickness two arrangements may be adopted, viz. either single or double Flemish bond. In the single mode, a wall two bricks thick shows Flemish bond on one side only, whilst it shows English bond on the other, the English bond being put inside. Double Flemish bond implies that this bond appears on both sides of the wall; PASLEY, *Outline*, 4to., Chatham, 1826, p. 65. The differences between this and English bond are illustrated in the diagrams given s. v. BOND.

Flemish bond was introduced into this country during the reign of William III, according to a general belief, which is not correct, for the works of Inigo Jones are mostly, and those of Sir C. Wren almost entirely, executed in Flemish bond. HOSKING, in 'Construction', in the *Encyc. Brit.*, 8th edit., states that being in those "countries where Flemish bond ought most to abound, if the name be properly applied, enabled the writer to observe what had never, to his knowledge, been remarked by any person who had published his remarks, and what was quite unknown to every one to whom he has stated, since his return, what he had observed: at Rotterdam, the Hague, Antwerp, Brussels, Liège, Cologne, Mayence, Frankfurt, and throughout the north-eastern parts of France, brick walls are built according to the arrangement distinguished in England as English bond, and no single example of Flemish bond fell under the writer's observation in any of the towns and countries indicated." FOWLER, jun., in *Transactions of the Royal Inst. of Brit. Architects*, 1849-50, remarks that in the mediæval brick buildings in the north-east of Germany, "the bond used throughout is the Flemish, or as it is there called, cross bond"; and in this Dictionary it is stated that Flemish bond is to be seen at Bruxelles.

It has been suggested that the term might have been derived from the word 'flemishing' used by workmen, and thus applied to brickwork as meaning work better 'finished off' than the other kind; and it may have been introduced at the period when red brick dressings were formed to openings. Perhaps the earliest dated examples of Flemish bond in London are

about 1680 at Chelsea hospital; and the writing hall at Christ's hospital, 1682, has English bond, while the red brick decorative part of the façade shows Flemish bond. The latter term is used in *LANGLEY, London Prices*, 8vo., London, 1750, 93.

FLEMISH AND DUTCH BRICKS, CLINKERS, AND TILES. In accordance with a very common custom, certain bricks and tiles, although now made in England, retain the epithet of Flemish, having been originally imported from Flanders. *WARE, Architecture*, fol., 1767, p. 59, speaks of them as being "very hard, of a dirty brimstone colour, some like the grey stocks, others yellower." The Dutch are generally the best baked, and the Flemish are the yellowest. As to the clinkers, they are the most baked of all, and commonly are warped by the heat. These bricks are used for paving yards, stables, and the like; the clinkers, in ovens." The size of the Flemish or Flanders brick is given in 1755 as $6\frac{1}{2}$ ins. long, $2\frac{1}{2}$ ins. wide, and $1\frac{1}{4}$ in. thick.

Seventy-two bricks if laid flat (which is rarely done) are allowed to the square yard in pavements. The clinkers 6 ins. long, 3 ins. broad, and 1 in. thick, are laid on edge, sometimes herring boned; when used in the stalls of stables they are frequently said to be too hot for the horse's feet. **CLINKER; DUTCH CLINKER; PAVING.**

The crypt of York cathedral was paved in 1415 with tiles, noticed in the *Fabrick Rolls* as "500 large Flaundre tiles" at 6s. 8d. per hundred, and 500 smaller tiles at 20d., and their carriage 8d.; the former are 11 ins. and the latter 7 ins. square, and all covered alternately with a yellow and a purple glaze; *BROWN, History*, 4to., 1847, 210.

FLEMISH MARBLE. A species of marble so called in Normandy, of which many modern fonts are made; but the locality from whence it is procured could not be ascertained, as stated by *RICKMAN, Attempt*, 4th edit., 8vo., Lond., 1835, 309.

FLESH RED. The name applied by *ANSTED, Elementary Course*, 8vo., London, 1850, to the reddish tint, for which he gives 'heavy spar' as the standard.

FLEUR-DE-LIS. The well known "somewhat stiff and conventional representation of a flower having two opposite petals turned back, the rest remaining closed and upright", as it is defined in the *ECCLESIOLOGIST Journal*, 1846, v, 209-12, which gives a good plate of examples of some of the many varieties of detail within this type. "One of the most common is where the three component parts are represented as detached, or as united by a band below which the petals sometimes expand again. Another variation is, that the tips of the side petals are frequently recurved; and again, that small detached pellets occur as adjuncts to the flower, both above and below the band" (*this appears to be an error for side petals*). "It will be seen that the band and the swelling-out of the petals below it, in the conventional fleur-de-lis, represent the seed vessel; the pellets above the flower, the stamens, and anthers; those below, probably, the seeds." The distinction attempted between the ecclesiastical and the heraldic fleur-de-lis in the same pages is less satisfactory than the account of the origin of the adoption of this form as an ornament, as a heraldic charge, and as an ecclesiastical emblem. Other illustrations are given in *PLANCHÉ, Pursuivant of Arms*, 8vo., London, 1852, repeated in the *BUILDER Journal*, 1851, ix, 718; and the use of the iris (for that flower seems to be commonly received as the origin of the ornament) in architectural decoration, such as the tracery of windows and of open parapets like those of S. Ouen at Rouen, occurs in various portions of *VIOLLET LE DUC, Dict.* 7. 14.

FLEURON. A French word which has been adopted by English authors for more than twenty-five years to denote not only a rose or other flower treated in any manner agreeable to a sculptor, but a calyx, a capsule, a pod, a fir cone, and indeed (as *flos* is used by *VITRUVIUS*, iv, 7, for the ornamental termination of the apex of the roof of circular buildings) for any crop or mass of foliage, such as that upon the choragic monument of Lysicrates at Athens. The word is most frequently used to denote any species of that conventional ornament which,

generally known as honeysuckle (Fr. *chèvrefeuille*) or *palmette*, was derived by the Greeks from the Assyrians, and appears either on a large scale, as on the ends of stelæ, etc.; or on a small scale, as in the necking of columns of the Ionic order in the Erechtheion (parodied in imitations of the Roman Doric), where it was technically called *ANTHEMION* according to the paper entitled *Athenian Sepulchral Marbles*, by *KINNARD, Unedited Antiquities of Athens*, fol., London, 1830. 25.

FLEXIBILITY. The property or quality of a body which allows it to be bent without impairing its normal powers of resistance. Flexibility differs from elasticity in this respect, that the former may exist in a body to an eminent degree without being accompanied by any tendency in the body to resume its original form; whereas elasticity only can be said to exist when the body, of which it is predicated, is able to redress itself directly the external force may be removed. It is on account of the flexibility of drawn iron that it is so well adapted to being made into chains, or to be woven into wire ropes; lead and zinc, copper, tin, and brass, are of variable degrees of flexibility; so also is glass at a high temperature; and indeed it may here be added that the flexibility of all metals is materially affected by heat. To such an extent is this the case, that iron or zinc, for instance, which can easily be bent in summer (or which are then flexible), become dangerously brittle in frosty weather. In small thicknesses wood is flexible; but perhaps it would be more correct to say that wood, and the whole class of substances such as gutta percha, caoutchouc, etc., are elastic, rather than to say that they are flexible. G. R. B.

FLEXIBLE STONE. A piece of flexible sandstone from Cawnpore, India, was placed in the museum of the Royal Institute of British Architects, April 1861. It is of a light reddish brown colour, and weighs about 132 lbs. per cubic foot. A specimen of Itacolumite, or flexible sandstone from the mountains of Itacolumi near Villa Rica, Brazil, occupies a case in the geological collection at the British Museum.

FLEXURE. The bending or curving of a line or figure is called, in the language of mathematics, its flexure; and a curve is said to have a contrary flexure when it turns in an opposite direction to the one it had originally followed. G. R. B.

FLEXURE is therefore the term by which the bending of a beam, a pillar, or a strut under a weight is accurately described; the word *DEFLECTION* being appropriated to the amount of flexure observed as deviation from parallelism with a previously fixed line. The flexure of marble and stone must have been for a long period under the eyes of numerous theorists as well as of practical men; not only in such a familiar example as the sagging of the mantle to a chimney-piece, but in the case of many a mullion; yet although the system of making walls as thin as possible has been more and more adopted for the last three or four centuries, little attention has been paid by scientific investigators in this country, to the relations of length, height, and thickness, at which a pillar, a pier, or a wall, begins to buckle. The regulations of the Metropolitan Building Act, 18 and 19 Vict., 1855, c. 122, may be compared with the opinions on this subject expressed by *RONDELET*, and later by *MORIN, CLAUDEL*, and others. The question of flexure in timber and iron has never yet been considered in all its bearings; the best authorities upon the subject are probably *BARLOW, On Strength of Timber*, etc., 8vo., London, 1837, p. 167, 186; and *HODGKINSON, Experimental Researches*, 8vo., London, 1846, p. 321-353; besides *LAMARLE*, noticed in the *CIVIL ENGINEER Journal*, 1844, vii, 264; *WARR, Dynamics*, 8vo., London, 1851, pp. 240-70.

FLIER. The name given to each step in a straight flight of stairs.

FLIGHT OF STEPS. The series of risers and treads from one landing-place to another: the flight may consist either of fliers only, or of winders only, or of fliers and winders.

FLINDERSIA AUSTRALIS. A native tree of New South Wales to which the name of red cedar is applied. CEDAR.

FLINT (It. *selce*; Sp. *silice*; Fr. *caillou*; Ger. *kiesel*). The usual name for the well known and nearly pure silicious earth, which becomes opaque and white by the action of fire; and is harder than quartz which it scratches. The colour is usually grey of various shades; but sometimes is black, brown, red, and even yellow; thin fragments of the black variety being translucent. Flint is fragile, with a perfect and large conchoidal fracture; being rarely laminated, it is broken with equal facility in almost every direction, and the fragments are sharp. It occupies a portion of the chalk formation, where it occurs in regular beds, consisting either of nodules or of flat tabular masses, which may be seen extending for a length of two miles in the chalk near Dover. It also occurs plentifully in alluvial deposits in the neighbourhood of chalk. Gravel, indeed, consists principally of flints which, after being rounded by attrition, have acquired a yellowish-red colour due to the peroxidation, through exposure to air and moisture, of the iron which they contain. The specific gravity is 2.594; and KLAPROTH'S analysis gave silica 98.0, lime 0.5, alumina 0.25, iron 0.25, and water 1.0; the substances with which it is mixed are to be considered as accidental ingredients. A silver sand is now substituted for this material in the manufacture of flint glass. Theories on the true origin of this substance are noticed in the first supplement to the PENNY CYCLOPEDIA.

At Brandon in Suffolk, one of the places where flint forms an article of commerce, it is obtained from pits sunk in the chalk, which is within 6 ft. of the surface. The first stratum is found in the clay overlying the chalk; when this has been removed a shaft is sunk 6 ft. in depth, if no flint is there found a tunnel is driven for 3 ft. horizontally and another shaft sunk; and so on alternately with tunnel and shaft till a depth of 40 ft. is reached; the flint is found in "floors" about 8 ft. below each other, and is obtained by tunnels being driven sometimes a furlong in length under each "floor" and the flint broken down by crowbars. The small tunnels in the shaft form tables upon which men stand and hand up the flint to each other from below to the surface; no machinery or tackling is used. **CHERT; FLINT WORK.** R. R. R.

FLINT (LIQUOR OF) and **(OIL OF)**, see **POTASH**; and **WATERGLASS**.

FLINT GLASS. The description of glass used for making decanters, wine-glasses, chandeliers, optical instruments, etc., is known in commerce by the name of flint glass, no doubt from the fact of its having formerly been obtained from pounded flints; on the continent it is known by the name of 'crystal'. It is remarkably dense, clear, and of great refractive powers. The composition of flint glass of the best quality is usually of one portion by weight of a caustic alkali (consisting in its turn of one-third of the nitrate and two-thirds of the carbonate of potash) to two portions in weight of the purest minium (an oxide of lead intermediate between the protoxide and the peroxide), and three portions in weight of the purest silicious sand; a small quantity of the oxide of manganese is added to correct the tendency of the other materials to assume a greenish tint, which would naturally occur if they were perfectly pure. The colours are given by the introduction of metallic oxides, such as iron, copper, cobalt, gold, uranium, etc.; the influence of oxygen on the colour or tint of flint glass was the subject of a paper read at the Inst. of Civil Engineers by F. Pellatt, April 18, 1849, and noticed in the *CIVIL ENGINEER Journal*, xii, 157. The various ingredients are carefully and intimately mixed in fire clay crucibles, and after being fused in an air cupola, the resulting mass is blown into the rough shapes intended to be produced; these are annealed in the cupola; and subsequently the glass is finished by being cut, or turned in the lathe. Borate of soda is sometimes mixed with the above named ingredients.

The *Annuaire du Bureau des Longitudes* gives the specific gravity of flint glass as being 3.33; its lineal dilatation is given as 0.000008167 for every increase of temperature equal to one

degree centigrade; and its cubical dilatation for every degree centigrade is 0.000002144: the index of refraction of a flint glass of a specific gravity equal 3.417 is stated to be 1.72339. **GLASS.** G. R. B.

FLINT WORK (Fr. *cailloutage*.) In districts where flints abound, they have been used from an early period for building and other purposes. They are of a gray or of a black colour, and they are used,—(1) *Rough*, or in their natural state as they are dug. (2) *Random*, or broken without any regard to regularity. (3) *Split*, so that the fractured surface is true on the face, and oval in form. (4) *Split and squared*, by which neat and square work in courses is produced. The three first-named form two kinds of masonry: viz. (1) *Perfectly irregular*, or random work. (2) *Regular courses*, in which the flints are worked to a level line as truly as their forms will admit.

The best dressed work in England will be found nearly to range in date with the use of flint locks to musketry, during that period gun flint (Fr. *pierre à fusil*) cutting, technically called "knapping," formed an important trade, and the workmen were from constant practice able to cut flints very neatly; varied tints were obtained by a mixture of flints obtained from the coast, from chalk, clay, and gravel, and horny looking weathered flints from the surface, with an occasional pebble and rough flint or header brick, all arranged artistically; thus, the sombre monotony so unpleasant in modern flint work was avoided.

Flint walls intended for durability should be not less than two feet in thickness, built slowly and solidly, flushed up with stiff strong mortar compounded of quick setting stone lime, and coarse sharp sand free from loam; as flint is a non-absorbent, bricks and tiles are often worked into the middle of the walls to assist in the induration of the mortar; but, for the sake of economy, lumps of chalk, pebbles, and flat bedded stones are frequently used as the principal components of the "core" or middle of the wall. It is very necessary to keep the work as dry as possible, not only during its erection, by covering it during rainy weather, and by avoiding grouting, but also after its completion, as the frost soon levels the work while saturated with wet. The flint itself being practically imperishable by the action of time and weather, and as "flint masonry becomes when perfectly set, a mass of concrete which resists almost any attempts to separate the several flints," it will produce substantial work, monumental in character, if great care be taken in its manipulation; but flint walls frequently fail by bulging while they are in course of construction, and splitting when they are old. "On any sufficient natural cause, as for instance, the giving way of the foundation," they are riven "into immense masses like so many fragments of rock;" hence, "a flint building gets out of repair less readily than a stone one, but if it suffer at all, it is very apt to become a complete ruin." To obviate these defects it is necessary to select the long flints called "bonders" or "wall-holds", and to use them as headers, the average number being three in every superficial yard; it is also advisable to work in occasional pieces of freestone as "through stones" which may form a diapered or rather chequered pattern (Fr. *bâti en damier*), 3 or 4 ins. within the face of the wall if the latter is to be wholly of flints; string-courses, buttress weatherings, quoins, jambstones, and similar dressings offer facilities for working bondstones entirely through the walls; but without due precaution, the flintwork while "green" (or new) is liable to shrink and settle from squared masonry. The best way to strengthen flint walls is by the introduction of what in Hampshire and the adjacent counties are called "lacing courses". They are of brick three or four courses deep, and do not always show outside; but at Cambridge, Brandon, and elsewhere, they do show, and are used every two or three feet. The object is not only to get a continuous bond, but to bring the work to a level bed, so that the irregular nodules of the flint may, as the workmen express it,

"start fair". The earliest specimen of this is in the Roman work of Richborough castle. Iron-hooping laid lengthwise and crossing diagonally between these brick courses will give great rigidity to the work, especially if it be bedded in cement.

When round flints are split and the thicker portion is kept as usual at the face of a wall, driving rains are readily conducted by the inclination of the upper bed of each course to the middle of the wall and by keeping it damp conduce to its decay; but as flints are seldom split at right angles to their axis they can be so laid in the work as to be flush on the face as well as level, or "fall to the square" on the upper bed, the lower bed must be firmly pinned up with fragments. As flint is not a laminated stone, it is as durable in one position as another; the fine laminæ occasionally seen upon the split surfaces are merely slight fissures accidentally caused by the hammer in striking an oblique blow. It is desirable that cavities for drainage, with exit holes at the plinth level, be formed in the middle of the wall by building in rods of wood or iron vertically, and drawing them up as the work progresses.

Flint will not form quoins or arches of large span; it has been suggested that to this difficulty may be attributed the prevalence in flint districts of round towers, and the absence of ailes to churches. Split and squared flints were used for external monochrome inlay upon a large scale in mediæval masonry, the surface of squared ashlar was sunk, and the flints carefully let in flush as panels and other ornamental forms.

Rough flints are sold by the ton (22 bushels), the other kinds by the bushel. A bushel of split flints and a bushel of lime, or $5\frac{1}{2}$ pecks of split and squared flints and $5\frac{1}{2}$ pecks of lime will face 1 superficial yard of wall $4\frac{1}{2}$ ins. thick; a face-waller and labourer will do 6 yards per day. 1 yard superficial 2 feet thick, will take 1 bushel split flints, 4 bushels rough flints, 5 bushels lime, and 10 bushels sand; of this work one face-waller (outside), one rough-waller (inside), and two labourers will do from $5\frac{1}{2}$ to 6 yards per day.

Taking reduced brickwork at 9d. per foot superficial, or £10 per rod (omitting fractions), and assuming the distances of cartage to be equal, flint walling 2 feet thick will bear the following relative prices.

All with rough backing. Per ft. superficial.

	s.	d.
Rough flints	0	8
Random	0	11
Gray split	1	5
Black split	1	6
Gray split and squared	1	7
Black split and squared	1	9

Twelve estimates submitted in competition for building a church in Kent, with a facework of brick, of flint, and of ragstone, showed a varying amount for the flint, of from £20 under the brick, to £100 over the brick in an amount of about £1550; whilst the third method was from £35 under, to £150 above, the brick; *BUILDER Journal*, ix, 210.

Flint is split upon the workman's knee, by sharp blows from a hammer with an oblate face, and squared upon a steel stake let into a wood block, with a blunt axe formed by passing a handle through an old flat file about a foot long, the cutting edge being $1\frac{1}{2}$ in. wide, by $\frac{1}{2}$ of an inch thick. The flint cutting trade is principally carried on at Brandon, and Icklingham, both in Suffolk. Roundly formed flints are frequently used for boulder paving, and broken flints make good macadamized roads; but those from the chalk are the most brittle and the soonest pulverized. Flint finely pounded is recommended as a durable covering for rough timber structures when they are payed over with three coats of hot tar and lime, and the silicious grains are firmly and smoothly imbedded therein with a trowel; *BUILDER Journal*, i, 311.

"In the chalk districts, the houses of the fifteenth century are frequently faced with flints cut and trimmed, and arranged with great skill and effect, of which there are fine examples at Nor-

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wich and Sandwich, and many others in different parts of Kent and Sussex," PARKER, *Dom. Arch.*, 8vo., London, 1859, iii, 23. A house in St. Andrew's, Norwich, next the cemetery, a fragment of the Decorated period of Gothic architecture, still remains; the squared flintwork is so delicately finished that a penknife can scarcely be inserted in the interstices. BRANDON, *Analysis*, and also his *Parish Churches*, show many examples of its employment in ecclesiastic buildings. *Proceedings of the Archæological Institute at Norwich, 1847*, p. 120-196; *Proceedings of the Somerset Arch. and Nat. Hist. Soc. 1854*, part ii, 8; THOMAS, *On the execution of Flint and Rubble Walling*, in the *BUILDER Journal*, xi, 605; POOLE, *Remarks on some—Norfolk churches—the use of flint*, read at the Yorkshire Architectural Society 1850, and given in *Reports, etc. of Associated Societies*, i, 85.

R. R. R.

FLINTY SLATE, or SILICIOUS SCHIST. This substance, found chiefly in beds in transition mountains, as the Pentland and Muirfoot hills in Scotland, the Isle of Skye, Bohemia, etc., is of various colours, as grey, bluish grey, and red; and is translucent on the edges. It is difficult to break, although the structure is rather slaty; and contains about 75 per cent. of silica, the remainder being lime, magnesia, and oxide of iron. Basanite, Lydian stone, or touchstone, which is considered to be a variety of this substance, though it has neither the slaty structure nor the hardness of flinty slate, occurs in Bohemia and Hungary, but was first brought from Lydia in Asia Minor. CHERT.

14.

FLITCH. The outside piece or slab of a balk of timber cut by the pit saw to reduce the stick to regular or parallel dimensions. FLAKE; SLAB.

A. A.

FLITCH, see GIRDER and PLANK.

FLITCROFT (HENRY), born 29 August 1697, was grandson of Jeffery Flitcroft of Twiss green, Winwick, Lancashire, and son of Jeffery Flitcroft, who became gardener to king William III at Hampton Court. He was apprenticed to Thomas Morris, citizen and joiner, November 6, 1711, for seven years; and on November 3, 1719, was admitted to the freedom of that company, of which in 1747 he was elected renter warden, and fined for not undertaking the office. He is said to have been noticed, whilst engaged in drawing, by the earl of Burlington, at whose house he had been working as a carpenter, and where he broke his leg by falling from a scaffold, probably about 1717-8. His name appears for the first time in a public manner, as draftsman on nearly all the hundred and thirty-six plates comprised in *The Designs of Inigo Jones*, edited by KENT, fol., London, 1727, for the publication of which work the earl provided the means; many of the original drawings for these plates are now in the library of the Royal Institute of British Architects. A volume of thirty two sheets of drawings and designs by him, consisting of the five orders of architecture, porticos, doorways, windows, ancient temples, vases, sections of S. Peter's at Rome and S. Paul's, London, the roof of the theatre at Oxford, etc. (apparently about 1750, if the last subject be a guide), is dedicated to "H.H. William duke of Cumberland", and is now in the royal library, British Museum.

Flitcroft was employed 14 May 1726 in the office of the Board of Works; he continued to be engaged as clerk of the works at Whitehall, St. James's, and Westminster, as also at Richmond and Kew, until 20 November 1746, when he was appointed master carpenter in place of Westby Gill deceased; 10 May 1748 he was appointed master mason on the death of Kent; and 10 March 1758 he was appointed comptroller of H.M. works in England on the death of Ripley, which office he held until his death, 25 February 1769, aged 72 years, being succeeded by 'W. Chambers, esq., architect to His Majesty'. GENTLEMAN'S MAGAZINE, and wherein the notice in 1758, pp. 166, 222, of Flitcroft's promotion to the office of comptroller, is an error; CHAMBERLAYNE, *Mag. Brit. Not.*, 8vo., passim.

Among his architectural works it is stated that in 1729 he

designed the seat of John Baynes, esq., in Essex, situated on the east side of the road leading from Havering to London (NICHOLS, *Progresses of Q. Elizabeth*, 4to., 1823, iii, 71); in 1733, the year after it had been purchased, he was commissioned to make the necessary alterations to the house, afterwards Carlton palace, for the reception of H.R.H. Frederick prince of Wales, son of king George II (PYNE, *Royal Residences*, 4to., 1819, iii); and he "is also said to have drawn a plan for the prince in 1734, intended as an improvement to Carleton house; and Kent designed a cascade for the garden in the same year, where a saloon was erected in 1735" (MALCOLM, *London*, 4to., 1803-7, iv, 268). For S. Giles-in-the-Fields, London, under a grant from the Commissioners for building new Churches, "Articles of agreement dated 9 June 1731 were entered into with Mr. Henry Flitcroft, architect; who contracted with the trustees—at his own costs and charges—to pull down the old church—and to build a substantial new church and steeple, expressed in such draughts or plans and proposals annexed as also the model thereof made and delivered by the said Henry Flitcroft, with a new vestry room, on or before 25th Dec. 1733." The amount to be paid, £7,030, was exceeded, Flitcroft's receipt being for £8,436:19:6, which was paid in six instalments of £1,000 each, the remainder on completion; all the old materials except the monuments were to belong to him. The model to a quarter scale, the 'proposals' or specification, and the agreement, were among the parish records in the time of PARTON, *Account of Hospital, etc., of S. Giles-in-the-Fields*, 4to., London, 1822, 211-5; DOBIE, *Hist. of S. Giles's Parish*, etc., 8vo., London, 1829, 117. The total cost appears to have been £10,026:15:9. The church is 75 ft. long and 60 ft. wide, and the steeple 165 ft. high; on the architrave in front of the tower is inscribed "H. Flitcroft, Architectus": the building has often been attributed to Hawksmoor. In the British Museum, the *Addit. MS.* 15,506, is a design for a new church retaining the old tower, the drawings are dated 1730, but are without a signature; in the royal library of the same establishment are two well shaded drawings of the church, probably of the date of erection; and two good engravings, from drawings by J. Donowell 1735. He also designed 1737-9 the church of S. Olave, Tooley-street, Southwark, costing £5,000; it is 82 ft. long and 59 ft. wide; this structure was materially injured by fire in 1843, but was restored by G. Allen with very slight alterations. The original drawings are in the above library, signed by himself and the churchwardens. A section is given in the *BUILDER Journal*, 1844, ii, 240, 253, 263, showing the spire which was not carried out, and one series of long windows, instead of the present unsightly arrangement: the same pages also contain extracts from the minutes of the vestry detailing the mode of electing the surveyor of 'proved ability'; his acceptance of 3½ in lieu of 4 per cent. for his commission; the mode of obtaining the contracts, etc.

An engraving of large size and in perspective, in the above library, of "Wentworth house, Yorkshire, the seat of Thomas earl of Malton", dated 1740, has on it the name of 'H. Flitcroft, Arch.', and of 'T. Schwerdfeyer, Delin.'; there is also a view of the garden front of the (old?) house, dated 1728; the first named print shows a centre with wings extending altogether to 600 ft.; the portico of six Corinthian columns is 60 ft. wide and 20 ft. in projection; this plate appeared 1770 at the end of the second edition of the work by Kent above mentioned, and also in that of 1835, the inscription of the owner being altered to 'marquess of Rockingham', a title granted in 1746. The building is described in ALLEN, *Yorkshire*; NEALE, *Seats*; WARNER, *Tour in Northern Counties*, 8vo., Bath, 1802, i, 200, etc., but without the name of any architect. Soon after 1747 Woburn abbey, Bedfordshire, for the duke of Bedford, with the stabling, were rebuilt from his designs; these are given in WOOLFE and GANNON, *Vit. Brit.*, fol., 1767, i, pl. 21-5 (and 25-8); the building was somewhat altered by H. Holland: S. John's church, Hampstead, 1745, consecrated 8 October

1747, was erected from his design (by Saunderson at a cost of about £5,000), while resident at Frogna in a house afterwards called Montagu Grove, where a portrait of him is said to have been preserved a few years since: 1747 he designed a house ("brick with five windows in front") for Lady Hervey (Molly Lepel) in S. James's-place, looking on to the Green Park, London, afterwards occupied by the earl of Moira; and 1749 Wimpole church, Cambridgeshire (Lysons, *Mag. Brit.*, 4to., 1808, p. 287).

Being of considerable repute and a citizen, he was elected sheriff of London and Middlesex June 1745, but paid the fine to be excused serving the office. A tablet and tombstone in Teddington churchyard, Middlesex, record his appointments of 'clerk, master mason, and comptroller'; and also the death of his only child Henry, a barrister, who died without issue 3 April 1826, aged 83 years. The Latin inscription on the tablet is given in LYSONS, *Environ.*, 4to., 1795, iii, p. 507; and in PARK, *Topography, etc., of Hampstead*, 8vo., London, 1818, pp. 222, 337. BRAYLEY, *Surrey*, 4to., 1841, v, 376; WALPOLE, *Anecdotes*; Books of the Joiners' Company; Accounts in the Chamberlain's Office; Notes contributed by G. R. Corner, esq., F.S.A.; Records of the Board of Works. W. P.

FLOAT, see BALL COCK.

FLOAT or FLOAT RULE. A strong straight edge of deal eight or ten feet in length, used as described in FLOATING COAT. ANGLE FLOAT; DARBY; QUIRK FLOAT. A. A.

FLOAT, or FLOAT STONE. A flat piece of stone or other material supported on the surface of the water in a cistern or boiler, partly by the fluid, and partly by a counter-weight; it is used either to show the height of the water, or to regulate the supply from or to the boiler or cistern. 23.

FLOATING, FLOUTING, or FLUTING. It is uncertain whether washing or rubbing be intended by this term in the passage "Fronts of old houses when the mortar is much decayed, are frequently floated down, the old decayed mortar raked out, and the joints pointed anew; so that they look, when done, nearly as well as when first built", which occurs in LANGLEY, *London Prices*, 8vo., 1750. FLOAT STONE.

FLOATING BRICK. The ancients were in possession of a method of making bricks, which, though they had very considerable strength, and remarkable power of resisting heat, were yet of such small specific gravity, that they floated on the surface of water. VITRUVIUS, ii, 3, and PLINY, xxxv, 14, say that they were made at Pitane in Æolia, and at two places in Spain, called Calentum, and Massia, Massilia, or Maxilva, and were used in the construction of buildings on the decks of large galleys, and other purposes. FABBRONI, *Di Una Singolarissima Specie di Mattoni*, 8vo., Firenze, 1794, after various experiments, about 1790 discovered that such bricks must have been composed of the substance called 'mountain meal,' an earth which, upon analysis, he found to contain 55 parts of flint earth or silica, 15 of magnesia, 12 of clay, 3 of lime, 1 of iron, and 14 of water. Bricks made of these materials had the property of floating in water; they could not be fused by any ordinary degree of heat, and so low was their conductive power, that while one end of the brick was red hot, the other could be held in the hand without the smallest inconvenience. FABBRONI found this 'mountain meal' in great abundance near Casteldelprano in Sicily. This may perhaps be the same as the substance under that name so plentiful in Cornwall. He also states these bricks to be very little inferior in strength to common (Italian?) bricks; if desired to be stronger, one twentieth part of alumina or pure alloy may be added to effect it. A brick 7 ins. long, 4½ ins. broad, and 1½ ins. thick, was 5 lbs. 6¾ ozs. in a compact common brick, and only 14½ ozs. in the floating brick. They unite with lime and resist water as efficiently as the common bricks, and they may be used burned or unburned; in burning they shrink very little, far less indeed than the common bricks, though they lose one-eighth of their weight and acquire a

sonorous or ringing quality; SURVEYOR, ENGINEER, etc., *Journal*, 1840, i, 80. The pamphlet above mentioned having now been obtained, it is requisite to notice that the name of Casteldelprano does not occur in it, and that the 'fossil meal' was discovered at Santa Fiora in the territory of Siena.

The dome of Sta. Sophia at Constantinople is generally stated to be built of bricks obtained from Rhodes, and of so light a nature that they will float; but SALZENBURG, *Alt Christliche Baudenkmale*, etc., fol., Berlin, 1854, states that these bricks are not to be found. A silicious earth found at Castagnati in Tuscany, and called 'fossil flour,' is said to form an equally light brick; and a portion of the soil of Berlin, containing a quantity of fossil infusoria, is also adapted for making bricks light of weight. Some bricks made from the clay in Woolwich Marshes are said by old brickmakers to have been so light that they floated on the water: as there were formerly large forests on each side the river, now submerged in the alluvial clay, the branches are still in many cases perfect, and even nuts are often found; the brick earth is thus full of ligneous fibre, which disappeared in the burning and left the brick of an open texture.

A. A.

FLOATING COAT. The second coat, in plastering, when three are employed. Narrow strips of plaster called screeds are first put on the wall or ceiling which has already received its first coat, and brought perfectly straight and out of winding by a long straight edge called a *float* or *float rule*. The remainder of the coat is then *filled in* by the trowel between the screeds, and also made true by the *range* of the darby. **FIRST COAT; SCREED.**

A. A.

FLOAT STONE. The name given by bricklayers to a piece of stone used for rubbing curved work to a smooth surface, such as the cylindrical backs and spherical heads of niches, to take out the axe marks: it is, therefore, made of a form reversed to that of the surface whereon it is to be applied. **FLOAT; FLOATING.**

FLOOD GATE. A door or gate placed at the outlet of a large land drain or sewer into a river for the purpose of excluding the water brought up to the outlet by a flood tide; and by extension a flood gate is now understood to mean any such door as may be fixed at the outfall of a drain into a ditch or sewer for the purpose of excluding the water brought down by a land flood, or by the regular return of a tide. Generally speaking these gates are hung on horizontal hinges fixed at the top, so that whenever the level of the water on the outside exceeds that of the water on the inside, the gate closes; occasionally, however, flood gates are made with one or more leaves turning upon vertical pivots placed a little within the centre line of the leaf or leaves, so that the latter may turn in a direction dependent upon the action of the water upon the longer lever, thus presented to it. Flood gates of this description are most frequently, and indeed almost exclusively used in tidal harbours, where scouring sluices are used. Both descriptions of gates may be executed in either wood or iron. **FLAP.**

G. R. B.

FLOOR (Gr. *πῖναξ*; Lat. *tabulatum*; Ital. *piano*; Sp. *piso*; Fr. *étage*; Ger. *stock*, *stockwerk*). The various horizontal ranges of chambers in a house, as basement floor, ground floor, first floor, mezzanine floor, second floor, etc., the expressions one pair, two pair, etc., implying the first, second, etc., stories above the ground floor. The principal floor is the story which contains the chief apartments, whether that be on the ground floor or on the first floor. **STORY.**

A. A.

FLOOR. The lower horizontal surface of a room. This has been made of rammed earth, asphalt or bitumen, tile, brick, stone, marble, etc., in which case it is generally called **PAVING**; but in England is commonly of wooden boards supported on timber joists. **COASSATIO; PLASTER FLOOR; PISÉ.**

A. A.

Notices of the floors used in the mediæval period in England are given in TURNER and PARKER, *Domestic Arch.*, 8vo., London, 1851-59. The various systems of framing will be found in the publications mentioned s. v. Carpentry.

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FLOOR in carpentry. The construction intended to carry the floor boards and ceiling, when wholly of timber, is known as **NAKED FLOOR**; **SINGLE FLOOR**; **DOUBLE FLOOR**; and **DOUBLE-FRAMED FLOOR**. These are composed of **BINDING BEAM**; **BINDING JOIST**; **BRIDGING JOIST**; **COMMON JOIST** or **JOIST**; **GIRDER**; **GROUND JOIST**; **TRIMMING JOIST**, and **CEILING JOIST**. Other terms, as **CARCASS FLOOR**; **CEILING FLOOR**; **PLANK FLOOR**; **PLATE**; **SLEEPER**; **STRUTTING**; **FRAMING**, etc., may also be consulted. A floor may also be formed of other construction, such as iron girders without joisting, covered with 3 in. deals, grooved, and tongued with iron; *BUILDER Journal*, xv, 606. Also by joists supporting thick glass slabs. **FLOOR, FIREPROOF.**

FLOOR (BARN). This, properly the threshing floor, was formerly and is sometimes still formed of 2 in. oak plank, free from sap, listed and doweled; or sometimes ploughed, or rebated, and tongued, on oak joists or sleepers 4 ins. square. The floor is best of oak if *well* seasoned, but as this is an expensive material, and also liable to cast and twist, the best 3 in. yellow deal is now more frequently used. The ground below should be excavated so as to allow a cat or dog to pass under to keep away rats. The fastening to the joists is better done by wood pins than by nails, for when the boards near the nail heads project the grain is crushed on them by the blow of the flail. In fact any irregularity is of great consequence from this very particular. The springing or vibration of the floor is also supposed to assist the action of the flail. To prevent grain falling through the joints, the boards are often ploughed and tongued, but this frequently causes the edges to split. Probably the most serviceable floors are those not nailed to the joists, but with fillets nailed under the interstices. An asphalt floor is not to be recommended, as it goes all at once when it begins to wear, and as it is non-absorbent, moisture hangs on its surface and injures the corn.

A. A.

FLOOR (BAY OF), see **BAY**.

FLOOR (FIREPROOF). A floor constructed of such materials and in such a manner that articles on fire shall neither cause damage to the room beneath, nor to the room over, should that be protected in a similar manner, which then may be termed a fireproof roof or ceiling to the room where the articles are burning. The introduction, etc., of this system in 1801 is noticed in HUMBER, *Practical Treatise on Iron*, fol., London, 1857, p. 100, pl. 56-7.

The modern constructive arrangements which may carry a flooring of brick, tile, paving, or wood, as each case may require, for this purpose, consist of:—

1. Brick or stone arches, vaulted or groined.
2. A flat arch of brickwork set in plaster, used in the south of France, is noticed by D'ESPIE, *On securing buildings from fire*, translated by DUTENS, 8vo., London, 1765, and improved upon by J. ARROW, 1768, as given in DOSSIE, *Agriculture*, 8vo., London, 1782, iii, 270. This system, as practised at Pisa, is detailed in *BUILDER Journal*, 1858, xvi, 94.
3. Hollow bricks forming an arch to a slight curve and through which a tension bar is passed secured at both ends; as Bunnett's patent self-supporting floor; *BUILDER Journal*, 1859, xvii, 55; *BUILDING NEWS Journal*, 1859, iv, 706.
4. Cast or wrought iron joists, between which arches of solid or hollow brick are turned.
5. Plate joists or girders filled in with concrete, in which are tubes of earthenware to lighten the load, as Beardmore's patent, described in *BUILDER Journal*, 1849, vii, 103.
6. Rolled iron joists, or girders with joists, filled in with concrete, as FOX AND BARRETT'S PATENT.
7. Iron girders with corrugated iron plate on the lower flange, filled in with concrete to receive fillets for the floor boards, as Cheyne's patent; *BUILDING NEWS Journal*, 1858, 1218.
8. The French systems of *planchers en fer* or wrought iron floors, known as *Système Vaux* and *Système Thuasne*: the first of rolled iron joists flat without flanges; the second rolled in the form of the double T; both systems being filled in with

P

concrete; as detailed by H. H. BURNELL, in *Transactions of Royal Inst. of Brit. Archs.*, 1853-4, 36-74, the discussions on which comprised references to most of the arrangements above mentioned. These papers are noticed in the *BAUZEITUNG* for 1854, pl. 632; and the systems are given in the *ANNALES DE LA CONSTRUCTION*, fol., Paris, 1856, ii, pl. 15, 16; DALY, *Revue Générale*, 1846, vii, 515, pl. 46; who also, xi, pl. 7-12, 29; and xvi, pl. 34, gives other French and English systems; some are noticed in FOWKE, *Report on the French Exposition of 1857*, reviewed in the *BUILDER* and *CIVIL ENGINEER Journals*.

9. Iron joists carrying stone landings, 3 ins. or more in thickness.

10. Grooved wrought iron bars carried on light framed girders, to receive the floor boards, the ceiling formed by plain tiles. Similar bars are used for roofs, receiving iron laths for slates; as Boydell's patent, *BUILDER Journal*, ix, 726.

The following schemes have been suggested for ordinary purposes, if not perfectly satisfactory for fireproof construction.

1. Timber joisting, having iron or copper plates laid over and under them, as HARTLEY's patent, *An Account*, etc., 8vo., London, 1785; 2nd edit., 8vo., 1834.

2. Timber joisting shaped Λ way, to receive brick arches turned between them, as used in France in the early part of the eighteenth century.

3. Timber joisting with a course of slates between, bedded in cement for air tight security, or covered with concrete to receive asphalt paving.

4. Timber joisting with laths of oak stronger than usual and placed at a wider interval; plaster of Paris, in the proportion of two parts of sand to one of plaster, being then poured in from above, passes through, and forms the ceiling below (being stopped on a kind of flat centering) and a sort of pugging above; the floor consisting of three courses of plain tiles; to form a perfectly fireproof and airproof chamber for a drying room; as at Messrs. Clowes's warehouse, London.

5. The FIBROUS SLAB, in conjunction with one or other of the above mentioned arrangements.

6. Timber joisting and floor covered with a layer of tiles; and the same with a coat of plaster of Paris, have been recommended for temporary purposes.

FLOOR (INLAIN), see MARQUETRY; MOSAIC; PARQUETRY.

FLOOR (LOAD ON Λ). In arranging the details of a floor it is necessary to allow not only for the amount, but also for the character of the load to be supported; because a permanent heavy load produces an effect upon the resistance of timber which may be conveniently expressed by the word 'fatigue'; whilst violent percussions, rolling weights, or other efforts repeated at regular intervals, may produce peculiar actions, equally injurious to the power of resistance. Again, the dimensions of the parts of a floor depend materially upon the depth which may be given to them, and upon the necessity which exists for preventing the passage of sound.

In ordinary buildings for house purposes, the strain to which a floor may be considered to be exposed, may be taken at a maximum at 120 lbs. per ft. superficial, without allowing for the weight of the floor itself, or for any partitions brought upon it; and the dimensions of the various timbers must be calculated upon the principles laid down in TREDGOLD, KRAFFT, RONDELET, EMY, or CLAUDEL. The practical formula given by TREDGOLD, *Carpentry*, 4to., Lond., 1840, is for the joists of single

framed floors, $d = \sqrt[3]{\frac{l^2}{b}} a$; in which d represents the depth in inches; l the length in feet of the bearing; b the breadth of the joists in inches; and a , a coefficient, which he makes 2.2 for fir, and 2.3 for oak. In framed floors TREDGOLD gives

the formulæ for the girders, $d = \sqrt[3]{\frac{l^2}{b}} a$, where the length

and breadth of the girder are given; and $b = \frac{l^2}{d^3} a$, when

the length and depth are given; in which the letters retain their former signification, but in which the co-efficients, a , become in the first case 4.2 for fir and 4.34 for oak, and in the second 7.4 for fir and 8.2 for oak. The general remarks upon the stiffness of beams supported at both ends which are contained in sec. iii, p. 79, of TREDGOLD, must, however, be carefully studied by those who are about to execute floors of any considerable dimensions.

G. R. B.

It is suggested that as the coefficients vary for every fresh case, that the former formula is the best, taking the deflection as not exceeding the fourteenth of an inch per foot, then

$$a = \frac{b d^3}{l^2 w}; \text{ or } b = \frac{l^2 w a}{d^3}; \text{ or } d = \sqrt[3]{\frac{a l^2 w}{b}}; \text{ where } a \text{ may be}$$

taken as from '01 to '013; this, however, gives a greater depth than the empirical rule of TREDGOLD. It may be useful to note that one-fifth of the breaking weight gives the depth very nearly the same as his tables.

G. A.

The weight of a floor of timber has been calculated at from 35 to 40 lbs per square foot; one on Barrett's system 78 lbs.; a half brick arch floor 70 lbs., and a brick arch floor 120 lbs.

The first named weight is suggested as far too much, 20 lbs. being nearer the correct weight; and though TREDGOLD gives 40 lbs. for a floor with iron girders, a floor for warehouses such as are required at the Docks, is there calculated at about 17 lbs. including girders, which with about 9 lbs. for plastering, allows 26 lbs. per superficial foot.

G. A.

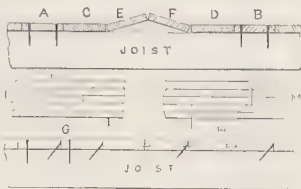
The weight of materials which are usually placed on floors will be given *s. v.* WEIGHT; but floors are generally reckoned to carry 2.5 cwt. per foot superficial, including their own weight; road bridges 5 cwt.; railway bridges 10 cwt.; *BUILDER Journal*, viii, 352. The failure of a floor, or rather of one of its girders, with a bearing of 18 ft., in Picardy-place, Edinburgh, about March 1833, is attributed to an assumed load of 51 lbs. of persons per foot superficial of floor, in the *Papers of the Corps of Royal Engineers*, 4to., London, 1845, vii, 87, which says that "floors should be constructed strong enough to carry a weight equal to 160 lbs. per foot superficial." The *ENGINEER'S ARCHITECT'S*, etc., *Pocket Book*, 8vo., Lond., 1861, 159, gives the following allowances: 1, in light workshops and factories, public halls, churches, and buildings in which people only congregate, and in warehouses for light goods, an allowance of $1\frac{1}{2}$ cwt. or 168 lbs. per square foot of floor surface as sufficient to include the weight of the joists or binders, of the floor, and of the load upon it; 2, in storehouses for heavy goods, or in factories in which heavy machinery, etc., is placed, an allowance of $2\frac{1}{2}$ cwt. or 280 lbs. per foot superficial, including joists, floor, and load. But it is evident that the latter allowance must vary according to the nature of the goods and the mode of storing them.

FLOOR or FLOOR BOARD, in joinery (Gr. *σάβις*; Lat. *tabula*; Ital. *tavola*, *asse*, *palco*; Sp. *suelo*; Fr. *plancher*; Ger. *fussboden*). The boarding laid on the joists as above stated. Floors are either *rough* (not planed) as for stable lofts, etc.: or are *wrought*, in which latter case they are laid in various ways.

1. In *folding floors* the boards, as Λ and B , are first nailed at such a distance that the intermediate boards cannot be got in except by great force. This is effected thus; c and d are put in loosely, e and f in the manner shewn in the cut. These last boards are then forced down by jumping on them, or by some power so that the boards c , e , f , d are jammed as tightly as possible between Λ and B ; they are then nailed in their places. This plan is well adapted for wood which is expected to shrink much, supposing it to be in an imperfectly shrunk state; if dried beyond the degree they are to remain in, the boards will inevitably buckle. The heading joints of each of these folds lie necessarily in one line, which has a bad effect, as shewn at m .

2. In *straight joint floors* the boards are flistered on the edges to a regular gauge, and adzed across where they rest on each joist so as to bed firmly thereon. Then each board is pressed closely against the one already laid, by wedging or by a

clamp. They are then either nailed in the ordinary way; or *skew nailed* or *edge nailed*, that is with one nail direct, and the other *askew* on the edge, so as not to be seen, as at G; or they are *dowelled* at one edge, and skew nailed at the other as at H, by which means no nailing is visible at



all. In these last described floors it was usual to plough and tongue the *heading joints*, which come irregularly, and break joint, as it may be termed, as L: it is now more usual to splay the heading joints, by which means the same nails secure both boards. As to their edges, the boards may be laid with *rough edges*, or they may be *shot*; they may also be *ploughed and tongued*; and either *feather tongued* with deal, oak, or mahogany, or tongued with iron hooping, though zinc is better than iron as avoiding rust. The varieties in each set of thicknesses used for floor boards are enumerated in the order of their increasing value by Gwilt, *Encyc.*, p. 603-4; also in handbooks of *Specifications*; and in the *Price Books*.

As floors, if laid early in a building, are likely to be injured, especially by the plasterers, and as it is difficult to carry on work without boards, it is now usual in good houses first to lay on the joisting a common rough floor of boards or battens, and then in a contrary direction to lay another floor over that one, either of clean deal or of battens about $3\frac{1}{2}$ ins. wide, or of wainscot, nailed in one of the ways described above; and further it is best to dowel the battens or boards at intervals of 6 or 8 ins., *i. e.* over the joists and in the middle of the space between each pair of joists: some workmen only dowel over the joists. The gauge should be run from the under surface of the boards, which should be previously straightened. In common floors the boards are always gauged from the upper side, then rebated from the lower side to the gauge lines, and the intermediate part adzed down in order to bring them to a uniform thickness. If, as is frequently the case, they are made too thin, they must be raised with chips, which present a very unstable resistance to any pressure upon the floor. **BATTEN; BOARD; PLANK.**

A. A.

12 $\frac{1}{2}$	12 ft. boards =	one square of rough boarding or flooring.
12 $\frac{3}{4}$	" =	" flooring, edges shot.
13	" =	" wrought and laid folding.
13 $\frac{1}{2}$	" =	" " straight joint.
14	" =	" " ploughed & tongued.
17	12 ft. battens =	" and laid folding.
18	" yellow =	" " straight joint.

Floor boards for ordinary buildings are formed of white or yellow deal according to their position: and they vary in thickness from $\frac{3}{4}$ in. (though $\frac{1}{2}$ in. is sometimes adopted by speculative builders) up to $1\frac{1}{4}$ in.; for shops and places of much traffic from 1 in. up to $1\frac{1}{2}$ in.; and for warehouses from $1\frac{1}{4}$ in. to 2 ins. The quality of battens for floors is divided into three kinds: the best is free from knots, shakes, sapwood, or cross-grained stuff, well matched and selected with great care; the second best is that in which only small but sound knots are permitted, yet it is free from sapwood and shakes; the inferior kind is that left after the selection of the other two.

The best floor boards are Dram and Christiania white deals; Stockholm and Gefle yellow deals are used for ground floors; Archangel, Gefle and Onega planks for warehouse floors and staircases; Petersburg, Onega and Christiania battens for best floors.

FLOOR BRAD, see BRAD.

FLOOR CLOTH. The so-called cloth is made partly of hemp and partly of flax; these are spun, and the canvas is woven, almost entirely in Scotland, and chiefly at Dundee; the degree of fineness is generally such as presents sixteen or eighteen threads to the linear inch. The pieces are usually

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300 ft. by 18 ft., 324 ft. by 21 ft., and 339 ft. by 24 ft.; but at the factory where the work is painted, these pieces, retaining their width, are cut into lengths of 100 ft. of the narrow widths, and 60 ft. for the width of 24 ft. A description of a visit to a floor cloth factory is given in the *BUILDER Journal*, 1858, xvi, 35. **KAMPTULICON.**

14.

FLOOR JOIST. The joist which supports the boards of a floor; but when the floor consists of binding and bridging joists, the latter are never called 'floor' joists.

1.

FLORENCE, and FLORENTIA. The English and Latin names respectively for FIRENZE in Italy.

FLORENTINE LAKE. A pigment of a red colour extracted from the shreds of scarlet cloth.

23.

FLORENTINE MARBLE. A name sometimes given to **LANDSCAPE MARBLE.**

FLORENTINE MOSAIC. A term applied, as shown by WYATT, *Specimens of Geometrical Mosaic*, fol., London, 1848, pp. 17 and 19, to two sorts of work, viz. the mediæval, and the modern manufacture as practised chiefly at Florence, of mosaic, each of which is known in Italy as *opera di commesso*. The principle of each is the same, that is to say the formation of mosaic work by slices of marble so cut that the projections of one piece "enter into the recesses of another: in that manner it produced, at first, geometrical and conventional forms and patterns; and, at a later period, pictorial representations." The same author traces the early style or method from the church of S. Miniato and the baptistery, through the works of Giotto at the campanile, of Brunellesco at the duomo, and Orcagna at Or San Michele at Florence, to the pavement by Beccafumi at Siena, where large and elaborate historical compositions are exhibited in light, half-tint, and shadow, by means of the contrast of three marbles. When further advantages as regarded pictorial representations were sought, the natural tints of the marbles were used to express shades and local colour; and the work, when fully carrying out the system of imitation, became what is now known as Florentine mosaic, the second variety of modern mosaic, according to the classification adopted by the author already cited, who, having placed as the first variety the Roman manufacture of pictures by means of small pieces of glass, defines the present subject as the assemblage of marbles, either alone, or with agate, and with jasper, in very thin slices or veneers, so arranged as to produce by their natural tints and shades tolerably perfect pictorial imitations of figures, flowers, fruit, ornaments, and even of structures—**FICTITIOUS ARCHITECTURE.** He adds that "in consequence of the extremely expensive character of this mosaic, its use has been, and is, very much restricted: still—considering that none but the hardest minerals are employed, that every piece of veneer must, in order to obtain additional strength, be backed by thicker slices of slate or some such material, and that every minute portion must be ground until it exactly corresponds with a pattern previously cut—we cannot but express surprise at the great quantity and the grand character of the works which have been, and are still, produced at the celebrated Grand Ducal 'Fabbrica'. Portions, lately completed, of an altar front intended for the chapel of the Medici at S. Lorenzo, far surpass any specimens yet executed at Florence." It may be added, the same system applied to pieces of differently coloured woods is called **MARQUETRY** work; and if applied to the admixture of mother-of-pearl or of brass with a dark wood, is termed **INLAY**; but if applied to the corresponding use of brass and tortoiseshell, is known as **buhl** (properly **BOULE**) work. **INTARSIATURA; VOLCANIC MOSAIC.**

FLORID ENGLISH or GOTHIC. A term applied by WARTON, MILLERS, HENRY, and others, to that phase of Pointed Art which, commencing about 1460 and lasting until 1537, is now known either as the Late Perpendicular or Tudor period of Pointed architecture.

1. 19.

FLORIN or FLORINO, see **PITUENZA (FLORINO DE).**

FLORIS, see **VRIENDT (CORNELIS DE).**

FLORY. A sort of blue colour used in painting. 4.

FLOUR (SAINT). The seat of a bishopric in the department of Cantal in France. The town, situated upon a hill of basalt, consists of narrow streets that are rendered sombre in appearance by the local material applied to the houses, which are all roofed with tiles. The small cathedral, dedicated to S. Flour, exhibits few traces of work earlier than the *style ogival tertiaire*; it was rebuilt 1452-83, and was reconsecrated 1496, but not completed until 1566; the towers were demolished 1593, but have recently been rebuilt. The ceiling, said to be a finely groined vaulting, rests on piers that have no capitals. The monastic establishments of *la Visitation* 1628, now an educational establishment, and of the Jacobins 1353 (?); the house of the Lazarists, and of the Jesuits 1590-1645; *la Recluse*, chiefly noticeable for two Romanesque arches; the episcopal palace, built by bishop Charles de Noailles 1610-51; a *séminaire* with a fine church; a high school; an hospital; and the *cour des assises*; are the chief other buildings. 14. 28. 50.

FLOURISH. A kind of flower work or other decoration. 4.

FLOURISHED. "The flourished with small beads, usually on the capitals of pilasters", is the description given of one of the moldings "which became common just before the Saxon style was abandoned", by DALLAWAY, *Anecdotes*, 8vo., London, 1800, p. 12.

FLOW (OF WATER). The architect has occasionally to consider the laws which regulate the flow of water, for the purpose of deciding the dimensions of the supply, or of the discharge, pipes of domestic service, and for proportioning the sizes and the inclinations of gutters, rain water pipes, and drains. It is true that in practice it is impossible to adhere to the strict indications of theory in these details of a building, because the disturbing effects of carelessness or of ignorance are often so great as to render it inexpedient to adopt the dimensions which really need only have been applied; but still it is desirable that the architect should from time to time verify his practical rules by a reference to the more abstract indications of science.

When water leaves a reservoir through an opening made in the side of the latter, if the side should be of considerable thickness, it is found that the area of the transverse section of the fluid vein, at a slight distance from the face of the reservoir, will be smaller than the area of the opening itself; a phenomenon known amongst hydraulicians by the term of 'the contraction of the fluid vein'; so that the discharge through a given opening ascertained from the initial head, or from the velocity of outflow, will require to be modified by a coefficient which in its turn is found to depend upon the form of the outlet. Thus, if the outlet be perfectly cylindrical, the discharge will only be, on the average, 0.62 of that theoretically due to the area of the discharge, and to the head as affecting the velocity; but if the end of the pipe converge towards a point exterior to the reservoir under an angle of $13\frac{1}{2}$ degrees, and the length of this cone be made equal to two and a half times the smaller diameter, the coefficient will rise to 0.95. It therefore follows that the end of a service pipe from a cistern should be made with what workmen call a bell mouth, of the above proportions. If it should, however, be desired simply to ensure the most rapid discharge from a reservoir through a pipe of short length, the orifice of discharge

(AJUTAGE) should be made as in the accompanying sketch, in which the distance from

A to B is equal to nine times the diameter of A, and the sides C D open out at an angle of $5^{\circ} 6'$. An orifice of this description will give an effective discharge equal to 1.46 of the theoretical discharge. This theoretical discharge is itself obtained by the formula $q = sv$, in which q = the discharge; s = the area of the opening; and v = the velocity; the velocity being ascertained by the formula $v = \sqrt{2gh}$; in which g = the accelerating force of gravity, and h the height from the centre of the orifice to the surface of the still

water above it, or in other words, the head of water over the orifice.

When the water drawn from a reservoir is to be subsequently used for the supply of a dwelling house, or even for a town distribution, the flow in the service pipes will be affected by the laws of friction developed by the form, and by the materials of the pipes; that is to say, it will be influenced by the length, the straightness or the curvature of the pipes, by the wet contour, and, in a minor degree, by the nature of the materials: and all these disturbing causes will equally in principle affect the discharge of water flowing through open channels, though in a different practical degree. The class of interferences to which reference is made, act, however, equally in the cases of water drawn from orifices in the side of reservoirs, where the contraction of the vein takes place on all sides, owing to the fact of the edges of the orifice being submerged, and in the case of water flowing over a waste-board or a weir. It may, therefore, be desirable at once to state that the discharge over the latter has been found by experiment to be on the average, 1, when the length of the overflow is equal to one-third of the channel of supply; and 2, when that length is equal in width to the said channel, as follows:—

1. $q = 0.60 l h \sqrt{g h}$; 2. $q = 0.665 l h \sqrt{g h}$; in which q = quantity discharged, l = length of the overflow, h = height of the surface of still water in the reservoir producing the stream flowing over, and g = the accelerating force of gravity (in England = $32\frac{1}{2}$ ft.); the head, h , being kept as nearly as possible equal to rather more than one third of the depth from the surface of still water to the bottom of the reservoir, close to the overflow. The coefficient of discharge may be increased by widening out the sides of the overflow: the above formulae are for openings in thin plates discharging water into the open air, or in such conditions as to ensure the uninterrupted discharge; and in both cases the level of the water surface is supposed to be constant.

The various laws of the flow of water in pipes and in channels are discussed at length, and in a familiar style by D'AUBUISSON, *Traité d'Hydraulique*, translated by BENNETT, 8vo., Boston, 1852; and in DOWNING, *Practical Hydraulics*, 8vo., London, 1855, to which works, and to the others mentioned below, the reader is referred for the details of this elaborate branch of the science of applied mathematics. For the purposes of the practical constructor it may suffice to say that the discharge through open channels may be calculated by the formula $q = sv$ as before; but in this case

$v = \sqrt{\frac{h}{l} \times \frac{s}{c}} \times a$, in which h = the difference of level of the top water line at the entrance and at the end of the channel; l = the length of the channel; s = the area of the cross section; c = the development of the wet contour; and a = a coefficient to be ascertained by experiment. This coefficient is usually taken at 100 for open channels and at 50 for cylindrical pipes flowing full bore, and with a constant velocity; so that the discharge through an open channel is represented with tolerable

accuracy by the formula $q = s \times 100 \sqrt{\frac{h}{l} \times \frac{s}{c}}$. The discharge through a straight pipe is equally represented, for practical purposes at least, by the formula $q = .7854 d^2 \times 50 \sqrt{\frac{h}{l}} \times d$;

d representing the diameter. Put into the usual form, this expression becomes $q = 39.27 \sqrt{\frac{h}{l}} \times d^{\frac{5}{2}}$ = the quantity in cubic feet discharged per second. DOWNING also gives the convenient formula subjoined for calculating the diameter of a pipe, which, with a given inclination, should discharge a given quantity of water

in a given time, viz.: $d = \sqrt[5]{\frac{q}{39.27 \times \frac{l}{h}}}$; and he further gives the formula for ascertaining the requisite inclination, $h = \left(\frac{q}{39.27} \right)^2 \times \frac{l}{d^5}$ when d is known.

In practice, it is found that the strict laws of hydraulics need not, and indeed cannot, be adhered to in calculating the dimensions of gutters, or the inclinations to be given to them, or to roofs; because the absorptive properties of the materials used, and the capillary actions of their separate parts, modify the conditions of the flow of water falling upon them. Thus, tile roofs are found to require in our latitudes an inclination of 33° ; whilst slate roofs executed with the larger kinds of Bangor slates may be made with an inclination of 27° ; and metal roofs, of either iron, zinc, lead, or copper may have a maximum inclination of 12° descending even to 8° . The longitudinal inclination found to be the most satisfactory in practice, for either trough or open gutters, is about one inch and a half in ten feet, or one-eightieth of the length; but if the velocity of flow of the water be increased by the introduction of a DRIP, the inclination may without inconvenience be diminished to one in 120. It may be added that the best velocity for water in house-service pipes is about 4 ft. per second; and that the circular drains should be laid with an inclination of one in eighty, not for the sake of a permanent, but for ensuring a temporary, velocity of the fluids they have to discharge.

MORIN, *Leçons de Mécanique Pratique*, 8vo., Paris, 1846; CLAUDEL, *Formules à l'usage de l'Ingénieur*, etc., 8vo., Paris, 1854; ROBISON, *System of Mechanical Philosophy*, 8vo., Edinburgh, 1822; WEISBACH, *Principles of the Mechanics of Machinery and Engineering*, 8vo., London, 1847; JAMIESON, *Mechanics of Fluids*, 8vo., London, 1848; BEARDMORE, *Hydraulic Tables*, 8vo., London, 1852; DWYER, *Hydraulic Engineering*, 8vo., Dublin, 1852; NEVILLE, *Hydraulic Tables*, 8vo., London, 1853; LESLIE, *On the Flow of Water through Pipes and Orifices*, read at the Institution of Civil Engineers 1855, and given in the *BUILDER Journal*, xiii, 81, 88. G. R. B.

FLOWER. This word, which has been used in the sense of FLEURON for "a representation of flowers or other ornaments by way of crowning or finishing on the top of a dome", as explained by NEVE, *Dict. s.v.*, is now the usual technical term not only for any conventional representation of any blossom, but for any combination of such representation with foliage or with ornament; indeed there is sometimes, as in many 'ceiling flowers', no imitation of a blossom at all. BALL-FLOWER; BOSS; PATERA; ROSE; etc.

FLOWER. The spelling used in 1632 for 'floor', as given in JUPP, *Carpenters' Company*, 8vo., London, 1848, 297, 302.

FLOWER, in decoration. The use of natural flowers in the preparation of temporary decorations, although often left to the skill of the architect on the Continent, is rarely submitted to his taste in England. *Practical Hints on the Floral Decoration of Churches*, by a LADY, with an Introduction by the Rev. W. Gresley, M.A., 8vo., London, 1858. A list of flowers for the immovable festivals of the church throughout the year, given in the *ECCLÉSIOLOGIST Journal*, 1845, v, 24, 53, 183, is amplified and corrected 1847, vii, 103. *Christmas Decorations in the London Churches*, in the *BUILDING NEWS Journal*, 1860, v, 33.

FLOWER BATTEN. A very hard, fine, close-grained, heavy wood of Ceylon; its polished surface shows a pleasing mottled pattern. 71.

FLOWERY (It. *florito*; Fr. *fleuri*). An epithet applied to spotted marble.

FLOWING GOTHIC, or POINTED, ARCHITECTURE.

These words, applied to the later portion of DECORATED architecture in England, are frequently employed as equivalent to the *Late complete gothic* of PETT; the *curvilinear* of SHARPE; and the *continuous or late middle pointed* of COX and JONES. The term FLOWING PERIOD, adopted, if not invented by FREEMAN (*ECCLÉSIOLOGIST Journal*, 1845, v, 24, 53, 183,) is derived from the character of the tracery. Thus he speaks of two types of middle pointed architecture, the one, with geometrical windows; deeply hollowed moldings; jambshafts; clustered columns; arcades; parts retaining a strongly marked individuality: the

other, with flowing tracery; channelled piers; panning; parts subordinate to the whole. In WEALE, *London*, 8vo., 1851, p. 156, mention is made of the tracery of the windows to the church of the Austin-Friars in Old Broad Street, as "of the flowing kind, the most uncommon in England, being confined to the reign of Edward III, (1327-77) and never in general use even then." WHEWELL, *Architectural Notes*, 8vo., Cambridge, 1842, p. 130, speaking of Germany, says that flowing tracery "occurs with most abundant variety of form in most of the gothic buildings: among others, in the cathedral at Freyburg, and with some very curious features in that at Strasburg." The same author, p. 31, had already stated that the church at Oppenheim (which in p. 91 he terms geometric decorated in style) "was built between 1262 and 1317, and is of a more advanced character than our English buildings of that date. The window tracery is of the flowing kind; the walls are covered with panneling and feathering; and their remarkably small thickness (not more than 18 ins.) is supported by rich and deep buttresses with crocketing, etc. The nave of York has flowing tracery and is said to be after 1320." Although a relationship between this phase of art and the FLAMBOYANT work of France seems to be denied by this author, pp. 39, 233, 252, 262, that subject appears to be entitled to further consideration; it is advocated in RICKMAN, *Attempt*, 8vo., Oxford, 1818, p. 153, in the following passage, "a tendency to the flamboyant style of tracery is frequently observable in the tracery of decorated windows, in the later period of the style, as in Bolton abbey;" and that work, gives besides other uses of the word, the great west window at York, and the east window at Carlisle, as perhaps the most elaborate specimens of flowing tracery work in England.

FLUE (It. *canna di cammino*, *fumajuolo*; Sp. *cañon de chimenea*; Fr. *tuyau de cheminée*; Ger. *kamin-röhre*, *schornstein*, *rauchfang*). This term, although commonly applied in the present day to the passage for smoke, as well as to tubes for the conveyance of cold and heated air, was perhaps first recognized as a portion of architectural nomenclature by NEVE, *Dict.*, 1736, who marks as additional to the edition of 1703, the following article: "*Flues*, small winding chimnies carried up into the main chimnies; also a sort of contrivance in hot-houses, etc., in gardens, to communicate heat to tender exotics." It does not appear that the word flue originally meant anything but a tube for air (Ger. *duerst-röhre*); for NEVE also says "the *funnel* of a chimney is the shaft, or smallest part of it, from the wast (where 'tis gathered into its least dimensions) upwards": 'tube', or rather 'tunnel', was at that time and till very recently a technical name for a smoke-flue, as 'chimney-tun' is at present in the west of England, although that term is reserved for a 'chimney pot' in the north. The Act of Parliament 4 Geo. III, 1764, c. 14, says 'funnel or flew'. It has already been observed that CHIMNEY was the name in the eighteenth century for the whole arrangement from the hearth to the top of the shaft, "designed for the convenience of firing, with a tube or tunnel to carry away the smoke", as NEVE says; and the late Latin *caminus*, *chaminus*, *cheminus*, and *chiminus*, the It. *cammino*, and the Fr. *cheminée*, all meaning a passage or way, curiously agree with the adoption, for the flue, of the word 'tunnel' which is now scarcely understood otherwise than as a means of passage for traffic.

As there are so few allusions to chimneys and chimney flues in classic writers, it has been conjectured that the smoke formerly merely escaped through a hole in the roof, in the same way as was the custom in early times in England. This was no doubt the case in country houses, as may be gathered from a well known passage in VIRGIL, *Ecl.* 1, "villarum culmina fumant"; and even in the present day, there are very many houses in Italy without a flue, the cooking being wholly done by charcoal, and the rooms warmed in winter by braziers (*focoli*). Although a passage in SÆTONTIUS, *Vitel.*, 8, reinforced as it is by another in SENECA, *Ep.*, 90, who clearly speaks of hot air

flues, might be considered with the authorities collected by BECKER, *Gallus*, ii, 1, to decide that the Romans had smoke flues: and although PALLADIO, BARBARO, and FERRARI, held that opinion, others maintain the negative; MAFFEI and MURATORI, each producing statements upon both sides, left the question undecided; RICH, *Illust. Comp.*, s. v. *caminus*, giving a view of a flue to a baker's oven attached to a wall at Pompeii (this is probably the flue discovered in October 1809, ACKERMANN, *Repository*, 1810, iii, 316), with notes of contrivances that at least must have had a short flue, in the centre of a room, intimates "the absence of anything like a chimney on the top of a building in the numerous landscapes portrayed by the Pompeian artists": the best evidence is perhaps afforded by the known existence of flues to the HYPOCAUST; yet MURATORI, *Antiquitates Ital.*, fol., Milan, 1738, ii, 417, seems to show that even at Rome the use of a hooded fire-place (and perhaps therefore of a flue) was a novelty in that city when two such conveniences were constructed there, 1368, for Francesco Carrara, in the fashion to which he had been accustomed at Padua. But an inscription over the gate of the Scuola di Sta. Maria della Carità at Venice, dated 1347, records that a number of chimneys were thrown down in that year by an earthquake. FLUE, EARTHENWARE.

The employment of a flue in England is noted in TURNER, *Domestic Architecture*, 8vo., London, 1851. He observes, p. xvii, that we look in vain among Saxon drawings for a chimney; that existing remains fully prove that vertical chimneys were constructed in this country in the twelfth century, which was certainly not always the case, the vent for the smoke being sometimes pierced through the wall (as at Conisburgh castle); that in the thirteenth century flues were ordinarily cylindrical shafts of masonry, carried above the ridge of the roof, though there is an example, at Aydon castle, of a chimney terminating at the parapet wall in a conical head, which is pierced laterally to allow the smoke to escape; that the commoner fashion, however, was to run the chimneys considerably higher than the roof; that they are invariably so represented in contemporary drawings; that orders to raise the chimneys of the king's houses are very frequent in the time of Henry III; that it appears by a precept of the same monarch that one flue sometimes was so constructed as to carry off the smoke of two fire-places; that chimneys continued in constant use throughout the fourteenth century also; and that, although not yet commonly used in the hall, in the other chambers their use was almost universal. Indeed the work here cited, ii, 88-91, 219, iii, 118, gives about twenty large illustrations of chimney tops, but without any indication of the size of their flues. The same author, noticing that although fire-places and chimneys were used at all periods in the other chambers, they were not so common in the hall, but that in the fifteenth century larger fire-places were introduced into the walls of the hall, where their situation varied extremely, adds, that in the sixteenth century clustered chimney shafts were of frequent occurrence.

It is remarkable that English writers, very much nearer the periods in question, have spoken of chimneys (flues) as unusual until their own time. The remark by LELAND, *Itinerary*, 8vo., Oxford, 1744, viii, 18 or 66, will be well known; and TURNER, iii, 227, suggests that LELAND's surprise might have been caused by flues suspended from the roof from a hood over the hearth to the walls. RICHE, *Farewell*, 4to., 1581, mentions Sir Christopher Hatton's house at Holdenby in Northamptonshire, not then fully finished, as having sundry chimneys casting forth several smokes, differing from the works then in use in many places, where the houses were built, as he says, "with a great number of chimnies, and yet the smoke comes forth at but one tunnel." To the same effect HARRISON, in his *Description* prefixed to HOLINSHED, *Chronicles*, fol., London, 1587, p. 189, says among the three things marvellously altered in England within the remembrance of old men was "the multitude of chimnies lately erected, whereas in their young daies

there were not above two or three, if so manie, in most uplandish townes of the realme (the religious houses, and manour places of their lords alwaies excepted, or peradventure some great personages), but each one made his fire against a reredosse in the hall." In like manner AUBREY, writing in 1678, *Antiquarian Repertory*, 4to., London, 1807, i, 69, says that "before the Reformation, ordinary men's houses, as copyholders and the like, had no chimneys but flues like loure holes; some of them were in being when I was a boy." This is perhaps the earliest instance that has been adduced of the use of the term, the distinction drawn by him between flues and chimneys may be noticed, as well as his idea of the nature of a flue: some difficulty in the above quotation may be met by remembering that chimney has meant not only the cover of the fire, but the place of the fire, and the flue.

VIOLLET LE DUC, *Diet.*, s. v. *cheminée*, after noticing the use of hypocausts according to the plan (about 820) of the monastery of S. Gall, states that kitchens, resembling great fire-places with one flue or more, were almost the only fire-places until the twelfth century. After that period the fire-place (and consequently the flue) became common enough to furnish him with several examples of chimney tops; to which may be added those given by DIDRON, *Annales Archéologiques*, 4to., Paris, 1846, pp. 163, 172; but neither of these works states the size of the flues. VIOLLET further mentions the manner in which the kitchen became in the thirteenth century a room with one fire-place or more, and gives, s. v. *cuisine*, amongst other illustrations, the kitchen of the abbey of Fontevault, to which the same authority has likened, in TURNER, i, 55, the building 7 ft. 6 ins. square and 27 ft. high, surmounted by a hollow cylinder with two rows of pillars at Quinéville, called la *grande cheminée*, which some writers have pronounced to be a Roman work; but the authority now cited considers it to be a chimney constructed at the end of the twelfth century. He also gives instances of the varied situation of fire-places in halls, and details the old manner of building flues projecting one before the other into the rooms, as still to be seen at the château de Pierrefonds.

FLUE (SHAPE, SIZE, AND CONSTRUCTION). The consideration of the defects of a flue, so far as regards its causing annoyance by descent of smoke into the room, belongs properly to the article SMOKE. Agreeing with BERNARD, *Sauvegarde pour ceux qui craignent la fumée*, in recommending against common opinion and practice that the opening of the flue should be larger at top, by one inch for every 20 ft. in height, than at the neck of the funnel or hood, SAVOT, *Arch. Franç.*, 12mo., Paris, 1624, calculates on the hood or funnel shaped portion reaching to the ceiling; and on the jambs being no longer widened as usual, but being carried straight up. At that period, also, it was customary to build the flue of an upper story before that of the room below it; and BLONDEL, in his notes to the edition of 1685, notices the invention of carrying flues, which then were 36 by 10 Fr. ins., or about 39½ by 11 Eng. ins., side by side, as usual in the shafts of the present day. The ultimatum of knowledge in 1703 upon the construction of a flue appears to be thus given in NEVE: "PALLADIO tells us, that 'the funnels of chimnies must be carried through the roof, 3, 4, or 5 ft. at least, that they may carry the smoke into the air. And here you must take care, says he, that they be made neither too wide nor too narrow; for if they be too wide, the wind will drive back the smoke into the room; and if they be too narrow, the smoke (not having free passage) returns back also.' Therefore 'tis, that chamber-chimnies are not made narrower than 10 or 11 ins., nor broader than 15, which is the ordinary depth of the funnels of great kitchen-chimnies, whose breadth is 4 or 5 ft. within the work, from the place where the breast ends, to the top of the funnel. Now the said breast reaches from the mantle-tree to the ceiling or pitch of the arch; always diminishing within the work, until you come to the measures of depth and breadth before mentioned; and from thence to the end of

the funnel, it must be carried up as even as you can possibly; for failing in this, it often happens the smoke is offensive." Afterwards GAUGER, *La Mécanique du Feu*, 12mo., Amsterdam, 1714, declaring that a large flue allowed two columns of air, one descending and the other ascending; and recommending that the opening at top should be no larger than necessary to let out the smoke, notices that diminution at top was common in Paris, supposes a flue 30 ins. by 10 ins., objects to a winding flue (Fr. *tuyau devoyé*, Ger. *geschleifte* or *schief-geführte kaminröhre*), argues against the assertion by DELORME that the bottom of a flue should be very wide, but admits that for a certain height the withs (*languettes*) should be as far apart as the jambs, and abuses that architect's notion of a DIAPHRAGM from the hood to 6 ins. above the top of the flue, but recommends dividing the top of the flue into several tops or pots, and in fact gives a design for a cross diaphragm as a cowl to the immense flue of the French houses. THE BUILDER'S DICTIONARY, 1734, says some make the funnel twisted, to prevent the smoke's descending too easily; but the better expedient is to make the funnel narrower at bottom than at top, the fire impelling it (*the smoke*) up more easy when (*the flue is*) contracted at the bottom; and in mounting it finds more space to disengage itself, and therefore will have less occasion to return into the room. FELIBIEN orders the mouth of the tube, or that part joined to the chimney back, to be a little narrower than the rest; that the smoke coming to be repelled downwards, meeting with this obstacle, may be prevented from getting into the room.

As much of the construction used in the eighteenth century in England was adopted from French customs, it seems useful to note that PATTE, *Mémoires*, 4to., Paris, 1769, p. 144, describing the method of building flues, notices that they still measured inside 36 Fr. ins. by 10 ins., except for small rooms, where 32 ins. by 9 ins. were used. Wood was universally burnt at this period in France.

The *Practical Treatise on Chimnies*, 12mo., Edinburgh, 1786, p. 7, a reprint from the *ENCYCLOPÆDIA BRITANNICA*, says "The Scots mason will please be informed that the word *chimney* in this essay is always employed in its proper sense, and means the tube that carries away the smoke from the apartment, which is by them usually called a *vent*. The fire-place and the grate are always distinguished by their proper names." This work gives an illustration of the old pyramidal flue, and of the (then) new flue of uniform plan to a much less size.

Science, in its present state, has not settled the best shape for the plan of a flue: the parallelogram of 14 ins. by 9 ins., however, continues to be generally adopted; because, even if it be the worst shape, it combines facility of construction with economy in cost of material and in space taken out of a room: indeed FRANKLIN, *Observations*, 8vo., London, 1787, says, "no form of the funnel of the chimney has any share in its operation or effect respecting smoke, except its height." The same author, considering the necessity for a large (fire-place) opening in a kitchen, advises "the building of two or more funnels, joining to the first, and having three moderate openings, one to each funnel, instead of one large one." WILLSON, in PUGIN, *Examples*, 4to., London, 1831-6, p. 56, pl. 9, describing Wolterton or East Barsham (or Basham) hall in Norfolk, and showing a stack of four pair of chimney tops, each 17 ins. in clear diameter, says "these chimneys are built upon the western gable of the hall, to which two of the tunnels belonged; two others were appropriated to the chamber over the hall, two to the parlour, two to the chamber above it, and the other two to fire-places in the garrets; such a large group of chimneys is scarcely to be seen in any other building of this date" (*i. e.* Henry VII); and he cites PLOT, *Staffordshire*, fol., Oxford, 1686, p. 359, for a notice of the hall chimney at Chillington (in Staffordshire) having no less than eight tunnels to one hearth. VIOLET LE DUC cites the grand salle of the château de Coucy as having a chimney divided into two fire-places, each having a pair of flues.

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The proper number of square inches for the plan of a flue has been left equally uncertain. Although WILLAN, editing WHITEHURST, *Observations on Ventilation*, etc., 4to., London, 1794, thought that 14 ins. square sufficiently answered for sittingrooms or bedrooms, but that "the area of a chimney in a large kitchen, where the family is very numerous, should be at least 588 sq. ins., whether its form be a square or a parallelogram"; the size of flues rapidly lessened. Thus in England, PASLEY, *Course of Practical Architecture*, fol., Chatham, 1826, noticed that 196 ins. were held to be sufficient for carrying off the smoke of the largest kitchen chimney, though 324 ins. had been advised, and that 81 ins. were thought enough for a common fire-place, though 126 ins. had been adopted for the admission of climbing sweeps. So also in France, MANDAR, *Etudes*, fol., Paris, 1826, p. 9, observed, "Il est reconnu depuis long-temps que les grandes dimensions des tuyaux des cheminées sont une des causes qui s'opposent à l'évacuation de la fumée, aussi s'est-on déterminé à les réduire à 2 pieds de longueur sur 9 pouces de largeur. 8 pouces de côté suffisent au passage de la fumée des foyers de Désarnod, ou autres du même genre"; and in a recent visit to Paris, it appeared that brick flues were hardly ever built, EARTHENWARE tubes 9 ins. by 8 ins., down to 6 ins. by 6 ins., being preferred. DOWNING, *Architecture of Country Houses*, 8vo., New York, 1850, p. 179, says that where wood is abundant and the fire-places large, the flues should be from 12 ins. to 24 ins. square, while the ordinary flue for coals should be 14 ins. by 9 ins. or 10 ins. in diameter, but for anthracite 12 ins. by 8 ins., or 8 ins. in diameter; and he recommends the builder to lessen the throat and the top, and to adopt the circular plan. The present state of legislation on the size of flues is somewhat in confusion; the Act 3 and 4 Vict. cap. 85, § 6, required that every chimney or flue hereafter to be built or rebuilt in any wall, or of greater length than 4 ft. out of the wall, not being a chimney or flue 12 ins. in diameter, should be in every section of the same not less than 14 ins. by 9 ins., and then provided the angles that were to be observed. This regulated all flues in Great Britain and Ireland: but its operation, within the limits of the Metropolitan Buildings Act, was repealed by the Act 7 and 8 Vict. cap. 84, which in schedule F decided that no flue might be used for a smoke-flue which was of less internal diameter in any section than 8½ ins. But as the Act 18 and 19 Vict. cap. 122, repealed that just named, without making any provision for the size of flues, it is understood that in the metropolis there is no restriction, *BUILDER Journal*, 1859, xvii, 623; which, in p. 278, gives as a recommendation from the Report to the General Board of Health by the Commissioners appointed to inquire into the warming and ventilation of dwellings, "that the chimney-flue be of small dimensions (not above 9 ins. diameter at the widest part)." This seems to involve the absurdity of compliance being obtained by a circle of 9 ins. diameter or 63 sq. ins., as well as by a rectangle 6½ ins. square or 42 sq. ins., which in the topmost rooms of some houses has lately been reduced to 40 ins., and if the common smoke-pipe from a stove be taken as a gauge, even less space may be hereafter allowed. ECKSTEIN, *On Chimneys*, 8vo., London, 1852, p. 111, on the other hand, has given, as the deductions from a long practice, the following dicta. The flue for a kitchen with a small fire-place, 14 ins. by 9 ins.; with a fire-place more than 42 ins. wide, 14 ins. by 14 ins., 18 ins. by 9 ins., or equivalent size; with a fire-place more than 72 ins. wide, 18 ins. by 14 ins., or equivalent size: but if the flue be less than 36 ft. high, he requires for these cases respectively 14 by 14, 18 by 14, and 18 by 18 ins. The flue for the ground and first floors in tall houses he settles at 14 ins. by 9 ins., and for the upper stories 14 ins. by 14 ins. The flue for the attic should, he thinks, be still larger till near the top, where they should be reduced to keep out the water: and with regard to kitchens upon an upper floor he recommends two flues of the size above given, or one flue equivalent to them, to be reduced at the top to about 150 ins.

Cottages, on the same principle, require a flue for the ground floor to be 14 ins. by 14 ins., and for the upper floor 18 ins. by 14 ins.

It is not clear that the usual system of building a flue on a plan of uniform shape and size from the bottom to the top is correct: the *BUILDER Journal*, 1849, vii, 489, contains a recommendation for making a sort of bulb for 24 ins. high just above the throat; and p. 573, another of making the flue 12 ins. in diameter except at 36 ins. above the throat, and 72 ins. below a 10 in. pot. The same *Journal*, 1853, xi, p. 141, contains a recommendation of widening the flue downwards; and p. 439, as well as in 1850, viii, 142, and 1851, ix, 254, of widening them upwards; ECKSTEIN, p. 53, says very clearly "though the general opinion is that flues should be constructed of equal size from the fire-place to the top, I contend that enlarging them at any point (except the opening for the fire-place) is not an impediment to the smoke passing, but will give additional power." SILVER, *Practical Treatise*, 8vo., Glasgow, 1836, advocates the widening of the flue upwards.

The writer of this paragraph was informed by a mill-owner, of a scientific turn, respecting one of his factory chimneys, which he pointed out, and which was built of brick on a square plan and parallel-sided externally, that he had it built widening internally by half-brick offsets from the bottom upwards, and that it was perfectly successful as to draft. J. W.

It is curious that practical men are not united in the opinion, refuted in the *BUILDER Journal*, 1851, ix, 243, that a flue should have a bend; and those who insist strongly upon the necessity of a bend have not yet defined what angle or curvature renders a bend easy for smoke. The advantages of sound construction are on all sides loudly vaunted, and practically neglected: few architects can vouch for the observation of their directions by the builder, and fewer builders can vouch for the sound execution of the flue by their workmen; many flues are rendered nuisances by a brick left in, which (by the way) shows that the pargetting was not properly cored; many a flue has a down draught of the smoke that passes through the with from its neighbour because the pargetting was badly done; and many a flue never smokes till the weather has raked out the little mortar patted on the sides of the bricks as the workman carried up the shaft. The architect who builds a stack in half-brick work may undoubtedly expect that the flue will be a nuisance. In half-brick chimney-breasts, imperfect joints and imperfect pargetting produce the passage of smoke into rooms, between the top of the plastering in one story and the bottom of that in the one next above it: this nuisance, and the danger ensuing from it, can be obviated by rough-rendering the chimney-breast from plaster to plaster. The Act of Parliament 12 George III, 1772, cap. 73, prescribed the system still followed of marking with lines of limewhite, on one side of a party wall, the course of the flues therein, so that when the adjoining owner built he would know where timbers might not run into the wall.

The bases of a long and successful practice in building flues are offered in the following observations. A flue as usually made for ordinary rooms in England is 14 ins. by 9 ins., and for kitchens 14 ins. square; the wings should be gathered over with an inverted funnel shape, having a rise of 2 for 3; the flue should be carried up with gentle curves, avoiding any sharp angle or elbow, and should have the upper part at least equal in area to the lower; the place of exit for the smoke should have a slight funnel shape avoiding any level surface at the top, as this tends to retain the smoke; and the flue should be carried to a sufficient height above the ridges of the roof; this height will vary with the pitch of the roof, but it should not be less than 6 ft. with a steep roof, nor less than 3 ft. with a flat one. But no flue may be expected to act properly until it is thoroughly dry. A flue does not always rise from a throat immediately over the fire; occasionally, as where it is necessary to have a fire-place under an opening, the flue starts at the

back or the side of the fire-place; and sometimes, starting either from over the fire itself or from over a false back, descends and is then connected by a horizontal flue or tube with a long ascending flue. One flue may run into another, but in this case a damper to close one of them when not in use is necessary. Where it is desirable to turn a flue at a very acute angle, a soot door should be placed at the elbow. The tops of flues have been frequently constructed with a side draught allowing the smoke to escape at the side, the top being covered; the early mediæval flues were generally, indeed, constructed in this way; and this side draught is particularly useful where it is impossible to raise the flue above an adjacent building, as it obviates the beating down of the smoke. In Italy the flues are frequently formed with an opening below the exit forming what may be called an underdraught; this much assists the draught of the flue by causing in it an upward motion of the air. *Illustrations*, s. v. Chimney Top. H. B. G.

The SOCIETY OF ARTS, etc., *Transactions* for 1815, p. 131, reprinted in *BUILDER Journal*, xv, p. 325, records as a communication by the Rev. T. Ridge, that if an elbow flue from a fire be carried into an upright flue, there will always be a large accumulation of soot below the elbow, and but little in the main flue; the cold air below the elbow condensing the smoke as it escapes, and turning it into soot which falls to the bottom of the flue. The late Mr. Thomas Cubitt is considered to have introduced the system of carrying all flues to the bottom of the house, thereby enabling them to be swept without entering into and disarranging the living rooms. But the proposal had been repeated by SYLVESTER, in the *Transactions* of the Society of Arts, 1841, liv, p. 162, whose suggestion that every flue should be built vertical, with the grate projecting in front of the breast, was followed by a recommendation in the *MECHANICS' MAGAZINE*, 1843, xxxviii, p. 322-3, of one flue being used for all the rooms of a house: this advice was repeated 1844, p. 290, in which volume, p. 217, occurs, perhaps for the first time, the assertion that 8 ins. square is sufficient for the free passage of smoke of any ordinary fire. In the *CIVIL ENGINEER Journal*, 1844, vii, 153, is an illustration of Denley's patent for earthenware tubes for smoke flues, one to each fire as is usual, and for dust flues, one from each fire into a main dust shaft to the basement. This might have suggested the proposition by Dr. SEARLE in the *BUILDER Journal*, 1851, ix, 641, of oblique tubes from every fire-place into a main flue from the kitchen; or that may have been due to the previous publication, p. 308, of the remarks on the system of *Smoke Condensation and Ventilation adopted at Osmaston Manor*, read by STEVENS, April 28, 1851, at the Royal Institute of British Architects, and given in the *Transactions*, 1850-51, which develop the system adopted of carrying all the flues for smoke and vitiated air underground to a main shaft, at such a distance that the extent of horizontal draught is 500 feet; the main shaft (1861) answers its purpose most effectually. A similar system, adapted likewise for warming and ventilating, where the circular shaft is erected within a square one and within the dwelling itself, is shewn in a house erected in the Isle of Wight, and given in the *BUILDER Journal*, 1860, xviii, p. 330. In the description of model buildings erected at Dudley, by W. Wigginton, given in the same *Journal*, 1855, xiii, 493, it is stated that "the smoke—will be conveyed by 9 in. tubes to a 12 in. central shaft—placed in the centre of a shaft 2 ft. 3 ins. wide, leaving a space on either side for a vitiated air chamber." But on p. 515, it is said that four flues instead of one smoke tube, were carried up, the action of one only not being satisfactory.

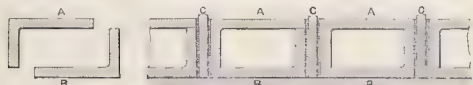
The practice of projecting the flues externally, prevailing in the domestic architecture of the Elizabethan period, is advantageous to adopt, if not inconsonant with the style, where the roofs are enclosed with parapets; inasmuch as the back of the chimney stacks can then be made to range flush with the back of the parapets, thus reducing and simplifying the gutters behind,

favouring economy in various other respects, and adding space to the apartments. J. W.


CRESSON'S computed table of the draught of (boiler?) flues, given in the *CIVIL ENGINEER Journal*, 1854, xvii, 400, from the *Journal* of the Franklin Institute, professes to show the quantity of air in cubic feet per minute that would be drawn through an opening one foot square by a flue of a given temperature during a fixed temperature of the atmosphere. It may be sufficient to suggest that the two conditions are so fluctuating that the calculations are not likely to be much employed except for the purposes of forced ventilation.

Besides the works to which reference has been made in the preceding paragraphs, the reader may consult ANDERSON, *Treatise on Chimneys*, 12mo., 1776; CHADLEY, *Formation of Flues*, etc., 8vo., n. d.; CLAVERING, *Construction of Chimneys*, 8vo., 1788 and 1793; DEARN, *Bricklayers' Guide*, 8vo., 1809; GOURLIER, *Essai sur la construction des tuyaux*, etc., 8vo., Paris, 1830; HEBBARD, *Caminiologie, ou manière de faire des cheminées que ne fument pas*, 8vo., Dijon, 1756; and GREGSON, *Cause, etc., of Smoky Chimneys*, 8vo., 1818.

FLUE (EARTHENWARE). The walls of the baths of the Greeks and Romans were lined with earthen tubes, sometimes fitting into each other, through which the flame and smoke circulated affording as much heated surface as possible. One sort from Piranesi is shown in pl. 2, fig. 5, in the illustrations to the *Detached Essay*, Baths and Washhouses; and another from the baths at Augusta Rauracorum (Basle), pl. 3, fig. 1, is referred to on p. 6. Those at Pompeii are formed of tiles with a hole at each corner, through which a large nail or clamp passes; this fixes them to the wall at such a distance that the smoke has room to pass between. Some flues were discovered at the villa of the Quinctilii on the Appian Way by Mr. A. Ashpitel, F.S.A., the construction of which was new to most of the Roman antiquaries of the time, and has probably not yet been published. They are of the simplest and cheapest con-



struction, being merely a sort of flange tiles, A, B, which are brought into contact with each other and the joint made tight with a flat tile, C, all of which are cemented to the wall and to each other, and like those of Pompeii are plastered outside. Another example of such flues existing in the baths of Caracalla, is shown in BROUET, *Restauration*, fol., Paris, 1828. A. A.

The modern use of EARTHENWARE pipes for flues is at least as old as the time of PATTE, *Mémoires*, 4to., Paris, 1769, p. 69, and may be seen put into execution outside buildings in almost every poor neighbourhood. It was neglected in favour of bricks molded to form, as the circular flues by HIOBT, whose patent dated 8 November 1825, is explained in his *Practical Treatise*, 8vo., London, 1826, which may be compared with MOON'S patent, dated 25 April 1843; and of tubes formed in metal by SMITH, whose patent, dated 14 September 1830, is explained in *Patent Metallic Lining*, 8vo., London, n. d. MANDAR, *Etudes*, p. 9, who shows his flues as contracting upwards, had in 1826 recommended "à les faire circulaires, ou même en fer fondu, ainsi que l'usage s'en est établi." The *BUILDER Journal*, 1849, vii, 57, 1860, xviii, 268, gives the statements made by HARDINGE as to the results of his patent (obtained in the name of Denley) dated 21 September 1843, for the application of iron-stoneware or terra-cotta circular tubes 9 ins. in diameter for flues, which were ultimately sold as drain pipes: a flue 7 ins. in diameter of the same sort for conveying the ashes from each floor to a pit in the basement formed part of the patent. Double earthenware tubes  were registered about 1848-50, the smaller one being for ventilation, according to W. WALKER, *Useful Hints*, 12mo., Manchester, 1850: such pipes are noticed in the *BUILDER Journal*, 1857, xv, 761, which, p.

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737, and xvi, 17, mentions the earthenware flue pipes with tubes in the angles for ventilation of rooms, patented by Jennings. This may be compared with a notice of work at Sydenham in the same *Journal*, 1858, xvi, 145. A flue, 2 miles in length, for a steam engine, is mentioned in the same work, 1850, viii, 562.

FLUED. This word is applied instead of SPAYED to a circular or semicircular splayed opening.

FLUIDITY. That state of bodies or substances in which the ultimate molecules are able to roll over one another without exercising any perceptible friction. A fluid body, from the extreme mobility of its particles, tends incessantly to spread in every lateral direction; fluids differ in this respect from *solids*, because the latter have no tendency to lateral extension except under the influence of heat; at the same time fluids differ from *vapours*, inasmuch as the latter not only tend to spread laterally but also vertically. It is known that, really the states of matter known by the names of solidity, fluidity, and vapour, are common to all unorganized bodies, and are dependent solely upon the amount of latent heat they may possess; for the densest and most irreducible solid bodies can be rendered fluid by the addition of caloric—the process known in the arts by the term *fusion*. FARADAY has lately shewn that many vapours formerly considered to be permanently elastic, are capable of condensation by extreme cold. Such metals as platinum, gold, silver, aluminium, lead, zinc, tin, copper, iron, and their alloys, are used in the arts by being run into moulds in their fluid state, and allowed to solidify in them, which they do in assuming the form of the mould they have been made to fill. Some minerals, such as mercury and naphtha, possess the property of fluidity at ordinary temperature. G. R. B.

FLUOR SPAR. The fluato of lime in its crystallized state is known in the arts by the name of fluor spar; the mineral, however, as frequently occurs in its massive state. The crystallized fluor has a lamellar structure, and is easily reduced to its primitive form of a regular octahedron; its colour varies through various shades of blue, green, red, purple, yellow and black: it is harder than calcareous spar; its specific gravity is about 3; and it is composed of 67.75 of lime and 32.25 of fluoric acid. It principally occurs in primitive mountains in veins, accompanying tin, quartz, mica, iron ore, calcareous spar, and sulphate of baryta, occasionally also in conjunction with lead. The fluor spar raised near Castleton in Derbyshire, was formerly much used for internal architectural and furniture decoration under the name of 'blue John'; but it is now seldom met with, although abundant in nature and of great beauty. The principal use of the mineral is in the manufacture of fluoric acid, which is used for the purpose of etching upon glass; PHILLIPS, *Mineralogy*, 12mo., London, 1817. G. R. B.

FLUSH. A technical word used by workmen to express that the highest part of a molding or object is in the same level or plane with the adjacent work. A. A.

FLUSH is also used as a verb by masons, who say that a stone has flushed, where more or less of its arrised edge has broken away in consequence of that edge being more loaded than the rest of the bed to which it belongs. It is remarkable that in the works of the Greeks there seems no evidence of any fear of such accidents; *CIVIL ENGINEER Journal*, 1844, vii, 241. SPALCHING.

FLUSH BEAD. A double quirked bead having its face level with the plane out of which the groove in which it rests is sunk. Sometimes there are two beads laid in a wide groove, as in the soffit of the architrave to the temple of Mars Ultor at Rome; but it must be observed that the flush bead, except as CABLEING to flutes, was never a favourite with the ancient architects. In modern times three or more have been put together so as to become REEDING.

FLUSH BOLT. A bolt sunk into the substance of work so that it is flush with the face of the material.

FLUSHING. The operation of suddenly letting a body of water escape from a reservoir with great velocity, for the pur-

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pose of removing any body which may exist in its passage. The velocity to be given to the water must of course depend upon the nature of the material to be removed, and it may serve to guide ordinary practical operations to state that the bottom velocity necessary to remove any one of the various materials named below are stated to be as follows by BEARDMORE, *Hydraulic Tables*, 8vo., London, 1852.

30 ft.	per minute	will partially remove clay from between sand and stones, in such a manner as to cause the latter to rearrange themselves.
40	"	will move along coarse sand.
60	"	" fine gravel.
120	"	" rounded pebbles.
180	"	" angular stones.

In flushing sewers, the operation of this description which most frequently comes within the province of an architect's duties, it is essential to bear in mind the fact that not only is it necessary to bring a given velocity to bear against an accumulation it may be desired to remove, but it is necessary to maintain that velocity after the materials have been once detached. A velocity of 60 ft. per second is the smallest that should be used for flushing long sewers. When flushing is resorted to for the purpose of maintaining a navigable channel in a port or in a river, it goes by the name of *scouring*. G. R. B.

FLUSHING. This word is used by workmen to signify the operation of filling in the joints of brickwork or of masonry with mortar, in such a manner as to keep the joints full. The mortar used in this work is made of the same tenacity as is required for ordinary work, in contradistinction to the liquid mortar used for grouting. It is usually supposed that the bed of mortar laid for one course is pressed, by the trowel that spreads it, into the joints left vacant in the course beneath it; which is a great fallacy, hence the necessity for **GROUTING** to obtain solid work. G. R. B.

FLUSH RING. A ring similarly let in as above described for a **FLUSH BOLT**.

FLUTE (Lat. *striz*; It. *scanalatura*; Sp. *estria*; Fr. *cannelure*; Ger. *cannelirung*). A channel of a segmental, semicircular, or elliptical shape, such as is frequently seen in the shaft of a column. **FILLET**; **CYPH**; **GROOVE**; **STRIA**. The application of this mode of breaking up a plain surface will be noticed *s. v.* **FLUTED WORK**. Its use in pillars dates as early as the tombs at BENTHASSAN and other Egyptian works noticed by FALKENER, *Museum*, 8vo., London, 1851, i, 87.

When a column is fluted, one flute is separated from another either by an arris or a fillet; and when a fluted shaft is in its place, the centre of a geometrical representation of its front is occupied by a flute; perhaps the only exceptions in antique works that have yet been noticed are furnished by the scene of the theatre at Segeste (Doric order) and the tomb of Theron at Agrigentum, the tomb removed from Xanthus to the British Museum, as well as a tomb at Antiphellus (Ionic order). This practice is also seen in the basalt capital with fifty-two flutes in the Egyptian gallery of the British Museum; and in the shafts having respectively forty-eight, forty, and thirty-two, at Persepolis, as well as in those with thirty-two at Nakht-chi-Rustam.

Number of Flutes.—Although VITRUVIUS, iv, 4, seems to admit of the use of twenty-eight or thirty-two for columns behind others, yet twenty and twenty-four are the numbers most usual. On columns of a Doric order executed under the influence of Greek art, the number is usually twenty, but cases exist of sixteen to the columns at Segeste above mentioned, to the lower and upper internal columns of the temple to Jupiter Panhellenius at Ægina, to the columns of the temple at Assos, and to those of the temple to Minerva at Sunium; FALKENER, i, 92, mentions others at Pæstum, and Syracuse. An engaged column at Soluntum is arranged for eighteen, and that number occurs at the largest temple in the citadel at Selinuntum, and at the temple of Diana at Syracuse. Twenty-four are counted on the shafts of the great temple at Pæstum, as well as

on those at the top of the interior of the Tower of the Winds at Athens. CANINA, *Ant. Etruria Maritt.*, fol., Rome, 1851, pl. 110, shows the upper portion of a pillar found at Vulci, with a capital very much resembling one belonging to a Roman Doric order, which has sixteen: one of the leading examples of a Doric order executed in Rome, viz., the baths of Diocletian, where twenty were employed as taught by VITRUVIUS, iv, 3, seems to have been taken as an authority by VIGNOLA; but the other Italian architects, who have been regarded as masters in modern times, adopted twenty-four for their specimens of that order when the shafts are fluted.

Twenty-four flutes as specified by VITRUVIUS, iii, 3, for shafts of the Ionic order, occur in almost every important example of the Greek and the Roman Ionic, Corinthian, and Composite orders, except in the cases of the columns of the tomb of Theron at Agrigentum, which, if not engaged, would have had eighteen; the temple to Apollo at Bassæ (and the smaller temple at Selinuntum according to CANINA, *Ant. Etr. Mar.*, pl. 124), as well as the temple to Fortuna Virilis at Rome, for the Ionic order; and except in the cases of the Tower of the Winds at Athens, the temple at Cnidus, and the temple to Vesta at Tivoli, for the other orders; which all have respectively twenty. CANINA, in the work above cited, pl. 121, gives the remains of a tetrastyle façade called the Grotta Pola at Soana, with columns each having a composed capital and a shaft divided into eight semicircular headed flutes separated by fillets. D'AVILER, *Cours*, 4to., Amsterdam, 1699, p. 69, seems to have noticed some antique shafts with thirty flutes.

Plan of Flutes.—The mode of obtaining the plan for shafts of the Doric order is stated by VITRUVIUS, iv, 3, to be the construction of a square upon the intended arrises of the flute, using the centre of that square as the centre for the curve (a segment) required; and iii, 3, he dictates that the plan of the flute for the shaft of the *Ionic order* is to be semicircular; the centre being not in the circumference of the shaft, but in a line drawn from one arris to the other; such at least is the effect of his direction to mark the course of the right angle forming the apex of a set square having its edges worked against the arrises. The plans adopted by the Greek artists for the flutes are generally shown as portions of simple curves, and the accuracy of the representations deserves investigation. Besides such evidence of those known to be elliptical as is supplied by the columns of the temple to Minerva and the propylæa at Sunium, with those in the portico of Philip and at the temple to Apollo in the island of Delos (Doric order), as well as the columns at the temple to Minerva Polias at Priene, and to Apollo at Bassæ (Ionic order), the information given by PENROSE, *Investigation*, etc., fol., London, 1851, p. 52, pl. 21, figs. 14, 15, 16 and 17 affords instances of the sections of the flutes of the columns which in almost all the cases at Athens are, he says, "formed by arcs of circles and are therefore portions of what are called false ellipses.—The templet or mould, which the workman used in shaping the flutes, seems to have been generally applied at every bed joint, and the intermediate space worked straight from one joint to another. In the Erechtheum, where the stones are much longer in proportion to the height of the column, it must have been used in the middle of each stone as well as at the bed joints, for in this temple the curve of the entasis is perceptible between the joints, which is not the case in the Parthenon." This author then notices that "as the flutes diminish with the columns, the mould or templet would require to be altered continually to suit the varying breadth of the flutes, in order to produce everywhere that similarity of figure, which is characteristic of the flutes of the Greek buildings of the best period"; and allows that for this purpose "the Greek architects, notwithstanding their love for mathematical curves, adopted an approximate instead of a true ellipse." He also instances the change taken by the plan of the flute, from that shewn by him fig. 14 serving for the greater part of the column, into that

marked fig. 15 which gives sharper cusps to the flute at the neck. This change occurs in the height (averaging about 2 ft. 9 ins.) of the upper stone; and the artifice, which in Athens at least is peculiar to the Parthenon, produces a delicate and beautiful effect of cast shadow and increased richness of molding. A somewhat similar mark of considerate execution appears to have been used in the Doric columns of the exterior of the propylæa and of the temple of Diana Propylæa at Eleusis; and to the temple of Ceres at Paestum. But at the Theseum and at the propylæa at Athens the flutes do not vary throughout their whole height; while at Eleusis, Sunium, and some other places, according to PENROSE, they appear to be shallower at the top than at the bottom. On the same plate, fig. 15a, is shown in elevation the curve by which the fillets of the flutes fall into the lowest of the annulets: the fillet at the neck is about .006 wide, and is proportionally increased to .0075 at the base of the column. In fig. 16 the section of the flutes of the columns of the pronaos of the Parthenon, as differing a little from that of the flutes in the peristyle, is given by the author above named, who notices that "the flutes of both orders of Doric columns in the propylæa are produced by single segments of circles, the radii of which equal the breadth of the flutes"; the flutes of the Ionic order are given in pl. 32. Fig. 17 shows the Ionic flute of the Erechtheum, which is rather more complicated, being drawn by means of four centres. And he corrects the drawing on a large scale of the plan of the flutes to the lower drums of the columns of the temple of Theseus as given in STUART and REVERT, 2nd edit., iii, pl. 12. Particular attention should be given to the flute shown at a large size from the temple of Jupiter Tonans by TAYLOR and CRESY, *Antiq. of Rome*, as it is more than half an ellipse. VIGNOLA shows the apex of an equilateral triangle based upon intended arrises, as the centre for the segmental flutes of his Doric order.

Top Finishings.—The mode in which the tops of flutes to columns of a Doric order executed under the influence of Greek art, have been finished, has also not been very carefully explained by archaeologists. In one of the usually received methods, the flutes seen in geometrical elevation show their end in a sort of apothesis under the lowest annulet of the capital, as illustrated to a large scale from the propylæa and temple of Ceres at Eleusis, in the SOCIETY OF DILETTANTI, *Unedited Antiquities of Attica*, fol., London, 1817. In another method the upper part of the flute dies under the bottom annulet leaving a flat soffit to the annulet, as at the propylæa at Athens, so that there is scarcely any appearance of the end in a geometrical elevation. In a third method the flutes turn so much under the lower annulet, that in a geometrical elevation their termination is unseen, as in the cases of the great temple at Paestum, and of the temple at Cadachio. The following appear to be exceptional modes of executing this part of a pillar. The flutes die into the apothesis at the largest temple on the acropolis at Selinuntum; while at the smallest of the three temples on the same acropolis, the flutes die into a prolongation of the chamfer of the ovolo, and therefore have the intersection described geometrically as a segment with the bottom of the lowest annulet for its chord; a similar termination is said to have been executed on the columns of the portico of Philip in the island of Delos. Instead of any apothesis there is a sort of cavetto forming a necking into which the flutes die at the temple to Hercules at Agrigentum, at the small temple near the acropolis at Selinuntum, and at the temple to Diana at Syracuse; while the lower end of the cavetto meets the upright surface of the shaft of the columns to the temple of middle size on the acropolis, and to the large temple near the acropolis at Selinuntum, so abruptly that the flutes, by cutting through the cavetto, have a sort of segmental end. This cavetto is bounded by a bead and the flutes end in the underside of a fillet below it, at the temple to Ceres at Paestum; where the basilica has the same termination to the flutes without the bead: at the smaller temple there the flutes do not quite reach

the edge of this fillet. The flutes of the engaged columns at Halicarnassus butt against the soffit of the bottom molding of the capital. In one example found at Priene, and in the colonnade near the lower theatre at Cnidus, the flutes butt into the soffit of a small band left under the bottom annulet; while in the temple to Apollo at Cora this band is very much enlarged, and the soffit slightly drops toward the axis of the shaft, so that the flutes in geometrical elevation have a square top with the soffit visible. The flutes of the columns (Doric order) at the top of the interior of the Tower of the Winds at Athens end semicircularly. Palladio and Vignola in their Doric order made the top of the flutes elliptical or perhaps nearly segmental, but the other Italian masters gave a nearly semicircular termination under the apothesis to the flutes in all their orders. The words 'nearly semicircular' are intended to remind the student that a true semicircle cannot be traced by turning a pair of compasses upon a curved surface; and that therefore, according to the size of the shaft and the number of flutes, a termination so drawn will more or less resemble an ellipse with a horizontal minor axis. Whether the plan of the flute be segmental, elliptic, or semicircular, the nearly semicircular termination could be given to it, though an elliptic form seems to have been preferred in the Greek Ionic examples; and where the plan is decidedly elliptic, the termination would naturally assume the same shape with a horizontal major axis, thus INWOOD, *Erechtheum*, fol., London, 1827, p. 105, says of that building that "the flutings are in imitation of those of the Ilissus; they are sunk elliptically, and finish with the same form at the upper and lower diameters." The same remark applies to the ends of the flutes of the same order in the temple to Fortuna Virilis at Rome. As exceptional cases it may be sufficient to notice the Ionic order in the smaller temple at Selinuntum, which CANINA, *Ant. Etruria Maritt.*, pl. 124, shows as having its unfluted flutes butting against a plain band left under the Ionic capital, like those of the same order to the tomb of Theron at Agrigentum, and to a tomb at Antiphellus. The temple to Vesta at Tivoli has its flutes butting into the sloped soffit of a plain space below the astragal; and the temple to Augustus at Pola has the flutes stopped by the astragal of the Corinthian capital. Besides these, notice should be taken of the peculiar method of stopping a flute exhibited in the capitals of the Choragic monument of Lysicrates at Athens; of the vases which fill the heads of the flutes to the columns of the temple to Jupiter Panhellenius at Aizani (Ionic order); and of the column at Paestum shown in MAUCH, pl. 59.

Bottom Finishings.—The bottoms of the flutes in columns of a Doric order executed under the influence of Greek art, are finished by stopping the flute on the pavements; perhaps the only exceptions are those in which the lower portion of the shaft is left either perfectly round or faceted as hereafter mentioned, in which the flute is stopped square at a certain height. Palladio and Vignola, in their Doric order having base moldings, made the bottom of the flutes elliptical or perhaps nearly segmental; but except Vignola, whose flute to his Ionic order ends square, the other Italian masters gave the flutes in all their orders a nearly semicircular termination. This shape might be said to prevail in the Greek and Roman works not of the Doric order, were not the elliptic preferred in the Ionic order of the Greeks and in the columns of that order to the temple of Fortuna Virilis at Rome. In all orders but the Doric, the ancient and modern architects made the flute end above the apophysis; the exceptional cases are those in which the flute ends abruptly on the base, as in the column of the smaller temple at Selinuntum, given by CANINA, *Ant. Etr. Marit.*, pl. 124, and of the tomb of Theron at Agrigentum, both of the Ionic order: those in which the flute descends on to the apophysis and there ends itself, as at the temple to Bacchus at Teos; the temple to Minerva Polias at Athens, and at Priene; or even descends into the apophysis and there ends itself, as in the case of the columns to the temple to Apollo at Bassæ (Ionic order), and of

those to the arch of the Sergii at Pola (Corinthian order); those in which the flute is stopped by a chamfer and the fillet by a higher chamfer as in the temple to Vesta at Tivoli (Corinthian order); those in which the flute ending semicircularly has a sort of stop in the bottom of it, as on the columns of the temple to Vesta at Rome; or with a higher stop, as on the two columns on each side of the high altar in the Pantheon at Rome; those in which the flute ends square and leaves a wide plain band at the bottom of the shaft, as on the columns of a tomb at Mylassa, where the lower third of the shaft is left plain.

Side Finishings.—Inosculating columns are troublesome enough even when the shafts are plain, but when they are fluted there is perhaps no better means of meeting the increased difficulty than that employed in the agora at Aphrodisias, where the junction is contained in a flute. There the columns are also engaged with a pier, and the junction leaves a half flute, as is the case with the bull headed shafts in the island of Delos. Probably this expedient is not quite so facile in execution as the mode adopted at Athens of which INWOOD, *Erechtheum*, p. 106, says: "The method of finishing the last flute that adjoins the wall of attached columns is seen in this temple, by making the flute rather larger at the upper diameter than the other flutes, and terminating it against the wall at the top with a whole fillet, which is continued down the same width to the lower diameter, leaving the flute below somewhat less than the other. By this expedient a fillet terminates the fluting of the column against the wall, and their little variation in size becomes scarcely perceptible; they (the flutes) were sunk semicircularly, which was also adopted to the semi-columns of the Choragic temple of Lysicrates, perhaps considering the semicircular form better adapted to conceal the expedient of terminating the fluting than the ellipse." The engaged columns with twenty flutes of the temple to Fortuna Virilis at Rome (Ionic order), and of the temple at Cnidus (Corinthian order) show nine with fillets against the wall, while those with twenty flutes at Bassæ (Ionic order) show eleven with fillets against the pier.

Size of Flutes.—The width of a flute and of the fillet, and perhaps of the arris, at the top of a shaft is less than at the bottom, in consequence of the diminution of the shaft; the proportion of the fillet to the flute does not seem invariable in ancient works. The custom of measuring the depth of a flute from a rule pressed against the arrises or fillets, renders it necessary for the student to set out the shaft with its divisions, and then to endeavour to mark the flute according to its dimensions, before he can ascertain the distance between the chord and the circumference; the assertion may be hazarded that the depth of flutes was settled in ancient times at a simple fraction of the distance from centre to centre of the arris or flute set back from the circumference of the shaft. This statement made unreservedly with regard to shafts of the Doric order, appears to hold good with reference to shafts of the Ionic order with segmental flutes; D'AVILER, p. 69, insists that it is correct for fillets with a semicircular plan, and might have cited all the edifices of ancient Rome except the temples to Mars Ultor and Jupiter Tonans, where the flutes are elliptic. Modern architects have usually made their flutes in the proportion of 5·0 wide by 2·5 deep, with a fillet 2·0 wide, as in Vignola's Composite order; but the proportions of the width of the fillet to that of the flute vary widely in ancient work.

With regard to the number of flutes for the wide face of a pilaster, three appear in the grotto Pola at Soana, and five in the baths of Diocletian at Rome and in the temple to Augustus at Pola; while nine occur in the Pantheon, where, as D'AVILER, p. 69, observes there is an astragal or bead at the angle, as the fillet would not be solid enough: this author justly advocates the use of seven flutes when the pilaster is fluted.

Absence of Flutes.—In Greek works, at least of the Doric order, as the fluting under the capital formed part of the same block as the capital, it was executed before the latter was

put up; and, a few inches of the bottom drum of the shaft having been also fluted previously to the block being fixed on its bed, these served as fixed points to guide the curved line which formed the entasis of the columns when the remainder of the fluting to the shaft was executed, that is, after the column was erected. PENROSE, p. 24, mentions part of the fluting of a shaft at the Parthenon, as being left unfinished for about the size of a man's head; and adds that the line of the entasis along the fillet of the flute is accurately traced through this rough portion. Such unfinished pillars as those of the colonnade near the lower theatre at CNIDUS; of the temple to Ceres at Eleusis; to Nemesis at Rhamnus; and of the temple at Thoricus; and at Segeste; as well as two shafts at Pastum, and those at the temple to Apollo in the island of Delos, which all belong to the Doric order, were as evidently left for future completion as were the external columns of the temple to Apollo Didymæus at Branchidæ (Ionic order), although imitated in England and elsewhere as finished examples. The preparation for the flutes on the lower drums at Eleusis is very well shown in the *Ionian Antiquities*, ii, pl. 20, and also with those at Thoricus in the *Unedited Antiquities of Attica*, which notices the nine facets at back, and eleven flutes in front, of the columns to the pronaos of the temple to Nemesis at Rhamnus. And these facets raise a suspicion that the masons reduced the stone to a remarkably correct polygonal form before beginning to flute the shaft; if such were the fact, the columns to the portico of Philip in the island of Delos, and of the temple to Apollo at Cora (Doric order), as well as of the Agora at Aphrodisias (Ionic order), although in this last named instance some portion of the plain surface bears an inscription, will hardly serve any longer as precedents for leaving the lower third of a shaft unfluted or merely faceted. The Romans do not appear to have been so anxious as the Greeks to flute their columns; the temple at Kangovar, the theatre of Marcellus at Rome, and an example at Albano (Doric order); the aqueduct of Hadrian, and a colonnade at Athens, with the theatre of Marcellus, and the temple of Concord at Rome (Ionic order); as well as the temple at Aphrodisias, the Pantheon, the temple to Antoninus and Faustina, and the frontispiece of Nero, at Rome; as well as the temple to Augustus at Pola and the Incantada at Salonica (Corinthian order); with the theatre at Myra (Composite order), do not appear to have been marked for fluting any more than the Greek Ionic instances afforded by the columns of the temple to Juno at Samos, and of the baths at Cnidus.

Authorities besides those mentioned in the text, which have been consulted for the preceding remarks, have been TEXIER, *Asia Mineure*, fol., Paris, 1839; and *Arménie*, fol., Paris, 1842; MAUCH, *Neue Darstellung*, 4to., Potsdam, 1845; CLERISSEAU, *Antiquités*, fol., Paris, 1778; COCKERELL, *Temples at Egina and Bassæ*, fol., London, 1860; TAYLOR AND CRESY, *Antiquities of Rome*, fol., 1826; SERRADIFALCO, *Le Antichità della Sicilia*, fol., Palermo, 1842; STUART AND REVETT, *Athens*, fol., 1762, 1787, 1794, 1816; and *Unedited Antiquities*, fol., 1830; SOCIETY OF DILETTANTI, *Ionian Antiquities*, fol., 1769, 1797, 1840; which last work shows the wreathed flutes of the columns to the propylea at Aphrodisias.

At present the usual way is to fix columns in plain frustra, and to cut the flutes when the rest of the work is done. They are set out on the top and bottom and the arrises scribed from a long thin straight edge which will readily bend to the entasis of the column, and each line is carefully checked by a plumb bob.

A. A.

A sort of flute, which is in fact a wide groove, with fillets having their sides returned square to the back of the pseudo-flute, has been executed, as on the Corinthian pilasters of the Val de Grâce at Paris, which may have been copied from those in the interior of the Pantheon at Rome: this church possesses a baldachino with columns that are spirally fluted;

according to a system that appears to have been adopted at Aphrodisias as above noted, as well as in the temple to Jupiter Clitumnus near FORTIGNO. Other instances of spiral fluting may perhaps be found in very late Roman work; and a tradition of this feature is preserved in the spiral pillars of Byzantine and mediæval work. The GLOSSARY, *s. v.*, observes that fluted pillars or pilasters are found in some buildings erected during the middle ages, "as at the abbey of Lorsch on the Rhine, and the cathedrals of Langres and Autun in France", given in VIOLETT LE DUC, *Dict.*, *s. v.* Cannelure; "occasionally also channelings, in some degree resembling flutes, are cut in Norman pillars;" and it is remarkable that the flute, or rather curved surface like a flute, except in the shape of chamfers and deep hollows and (perhaps) half-flutes, is almost entirely absent from the details of Pointed art until the Perpendicular period; a remarkable exception exists in the window-jamb at Kingsthorpe, given in RICKMAN, *Attempt*, 8vo., London, 1848, p. 171. ARRIIS; CABLE; FILLET; PILASTER.

FLUTED WORK. The application of fluting as decoration. The necking of the capitals of the columns at the temple to Ceres and at the basilica at Pæstum (Doric order); the bells of the capitals to the columns and pilasters of the arch and tomb at Mylassa; the beautiful bell of a capital found at Delphi, as well as of one to a temple near the baths at Nîmes, and of another to a tomb at Mylassa; the balusters and volutes of the capital in most Greek examples of the Ionic order; the bases of columns as at Pasargada and Cnidus, as well as in the propylæa at Eleusis, and in the temple to Minerva Polias at Priene and at Athens, and others in the last named city; the frieze of the upper theatre at Cnidus, and of the Incantada at Salonica; and the frieze of a doorway at Patara, are perhaps of more importance than the fluting applied to the abacus of the capital in the classic and neo-classic Corinthian and Composite orders, and the same ornament in the corona of their cornices, and even in a cyma recta at the Maison Carrée at Nîmes.

Amongst other uses of this mode of ornamentation, it has been applied in mass on plane surfaces either in waved flutes, as in the instance of the side of a sarcophagus at Scopelo; or in straight flutes, as on the legs of the same example; or instead of reeded work in narrow panels, especially of pilasters: also in conventional ornament, as in the finial to the roof of the Choragic monument of Lysicrates at Athens; as well as to pateras, tazzas, vases, etc. It may also be placed among the most beautiful varieties of surface employed for ceilings as seen in the caldarium in the thermæ at Pompeii, and in some ruins at Castellone, the ancient Formie: it has likewise been used with success by the king's architect at Naples in the vaulted ceiling of a ball-room: and in the angle room to the court rooms, by H. Roberts, at Fishmongers' hall, London.

FLUTING, see FLOATING.

FLUX. A substance added to a material it may be desired to bring to a state of fluidity for the purpose of facilitating that operation, and also occasionally to purify the melting body by enabling its original impurities to form new compounds distinct from the first base. Thus limestone is a good flux for argillaceous, clay for calcareous, iron ores; while caustic alkalis are fluxes for silica in its various forms. BORATE; BORAX. G. R. B.

FLYER, see Flier.

FLYING BOND. When a brick wall is erected as a boundary, or merely for a temporary purpose, the courses are formed chiefly of stretchers on the faces, a header being occasionally used to bond the two together: this is called 'flying bond' or 'Yorkshire bond'. Such work at Little Wenham hall, Suffolk, dating about 1260 or 1280, is given in TURNER, *Domestic Arch.*, 8vo., London, 1851, p. 151.

FLYING BUTTRESS (It. *pintello*; Fr. *arc-boutant*; Ger. *strebe-pfeiler*) sometimes called arch-buttant; arch-buttress; arched buttment; arched buttress; bow or flying buttress, as in the Report upon Salisbury cathedral, 1669, by WREN, *PARCH.* PUB. SOC.

rentalia, fol., London, 1750, p. 304; and bower by WHITTINGTON, *Eccles. Antiq. of France*, 4to., London, 1809. A pier standing at some distance from a wall, to which it appears to be connected by a mass carried by an arch or a half-arch. When the supported mass rests upon, or is formed by, a half-arch, it is frequently called a 'rib', especially when its coping rakes. The pier is sometimes engaged in a wall, but it is seen isolated in several instances like that afforded by the chapter-house at Lincoln. The connexion of the supported mass with the main wall should not be constructional; that is to say, the riding wall should either butt against the main wall, or preferably should run into a chase left for it. When the buttress consists of a pier acting as an abutment to two stages of ribs, one over the other, it is termed in France *arc-boutant double*; and when a pier is put intermediately between the main pier and the wall, as in a five-ailed church, the entire buttress is said to be an *arc-boutant à double volée* by VIOLETT LE DUC, whose classification might have included, with equal precision, the term *arc-boutant double à double volée*.

Scientific writers are not agreed as to the purpose for which the flying buttress was intended, and consequently do not coincide in opinion as to the points at which, in the case of a rib, the riding wall and its half-arch should abut upon the main wall and the subsidiary wall or pier: some say that the flying buttress is to resist the thrusts from vaulting; others that it is to give factitious solidity to a wall that is so pierced as to be shaky; while a few believe that the Northern architects intended to gain both objects at once, and at the same time, or even principally, to fortify the wall under the pressure of the roof. Such was the purpose of those added to Westminster Hall, London, which have been lately found on the east side to be quite separated from the wall, thus affording it no support. The view that it was an adjunct to groined vaulting, and an opportunity for large windows, is taken decidedly by VIOLETT LE DUC, *Dict.*, *s. v.* 'arc-boutant', who says, p. 66, "toute la science des constructeurs consistait donc alors à établir un équilibre parfait entre la poussée des voûtes d'une part, et la poussée des arcs-boutants de l'autre." In the same article, pp. 64 and 79, he gives as the reason, why the riding wall should not be constructively a portion of the main wall, that it should be allowed to slip in accordance with any settlement of the main wall or of the pier. In the article 'Construction', pp. 136-144, 170, 177-182, he adds several illustrations to those given in that previously named, and continues the same theory. But if his diagrams appear rather to suggest that the flying buttress so pitches against the main wall as to seem to be intended to give stiffness to a wall already too thin for the weight of the roof, or too much pierced by windows to stand securely, that theory is still more forcibly supported by DE LASSAULX, as translated in WHEWELL, *Architectural Notes*, 8vo., Cambridge, 1842, p. 219, who, speaking of the church of S. Mauritius, 1144, at Cologne, which he calls a small church and with few exceptions consisting almost as it were of one piece, built upon arches and without any kind of buttresses, says: "There are so many old churches in the round-arch or Roman style, without buttresses, and which in later times were vaulted—as also others which at their foundation were destined to be furnished with them, but nevertheless do not possess them,—that their general erection, on the introduction of the Pointed style, cannot have originated in the belief that they were absolutely necessary, since it was sufficiently well known, then as now, that high pointed cross arches exert a smaller thrust in proportion than round arches;—their introduction manifestly originated in the desire, not only to avoid large blank surfaces of walls, but also to make everything lofty and transparent; in which case it was of course necessary to secure the proper stability by means of masses of wall placed transversely, from which were carried flying buttresses, for giving sufficient resistance to the point of pressure of the great vaults of the church-nave, over the light pierced galleries, which in England are

called *triforium*. Moreover, these flying buttresses have been found superfluous in the most recent restorations at the cathedral. It was necessary to remove them in order to restore the weather-worn parts, and in doing so they were found to be standing quite loose and tottering, and had consequently no supporting power. Also, with respect to the later mode of building churches, with three naves of almost equal height under one and the same roof, separated by slender pillars, we may remark, that in attentively considering such a simple construction, buttresses, whether external or internal, are quite superfluous. The side wall resists the thrust of the vault over the narrow side aisles, by the power which it has from a suitable height and weight. To strengthen it with a view to its resisting the pressure of the large middle vault, would therefore be quite superfluous, as it can never exert any influence upon it. Were this even to move, it must of necessity lift up the light vaulting of the aisles, and fracture or separate it, before it could press the external walls out of the perpendicular. This thrust of the middle vault must therefore be sustained by very different means; for which purpose a massive wall in all times has been imposed upon the piers, and is, moreover, loaded with the greater part of the roof. That buttresses continue to be used, arises from habit; but that some of the more sagacious architects in olden times knew them to be unnecessary, is proved by so many of the Jesuits' churches, as well as the before-described church of S. Peter (about 1750) at Mentz."

VIOLLET seems to consider that the flying buttress, which was known to the Romans as it is found in the Baths of Diocletian, made its appearance in France about the end of the twelfth century; and upon this subject the GLOSSARY, *s. v.* Buttress, has the following note: "the half-arches over the triforium at Durham, springing from the outer wall of the aisles to support the wall of the clerestory, are in principle flying buttresses, although under the roof of the aisle; they are good Norman work." Some flying buttresses of the Norman or Transition period are also to be seen over the north aisle of the choir to Canterbury cathedral. The invention of setting a flying buttress at the corner of a building so as to form in plan an obtuse angle with each main wall, appears to be due to the fourteenth century. Beautiful examples of a flying buttress occur in England in almost every large building of the Third Pointed period. In that later time the original uses of the flying buttress were lost sight of, and it was applied to wood carving, and even to works in metal. In the Renaissance style, the form was retained, although not always applied to resist a lateral thrust. WARE, *Treatise on the Properties of Arches*, etc., 8vo., 1809, and *Tracts on Vaults and Bridges*, 8vo., 1822, illustrates the use of flying buttresses. *Illustrations*, *s. v.* Buttress.

The term flying buttress might be given to the supports of such constructions as the spire of S. Dunstan's in the East, London, by Wren, and of the other works mentioned *s. v.* CROWN STEEPLE. It is curious that MACKENZIE, *Newcastle*, 4to., 1827, i, 254, says of the church of S. Nicolas in that town, that "the lateral pressure at the butment of the intersecting arches is counteracted by two strong oak beams, which are preserved by being covered with lead." The arches in the instance of S. Dunstan's are noticed as formed with horizontal courses. The flying buttress is also frequently used in England, especially in Lincolnshire, reaching from the angle of the tower to one of the faces or angles of the spire. APPODITIUM.

FLYING GROINS. A term explained by DALLAWAY, *Discourses*, 8vo., London, 1833, p. 173, as "composing a vaulting springing from corbels, supporting a pillar and its capital."

FLYING OF A CORNICE, VAULT, etc. The word 'flying' seems here to mean that a portion of the work does not bed upon another; as in the case of the architrave between two engaged columns when the entablature is not broken.

FODDER OF LEAD, see FOTHER.

FODERO AND FODERA. The Italian name for the casing by marble given to a building: it was properly the lining,

afterwards the furring, of a garment; and is specially used in speaking of the Sta. Casa at Loreto.

FOERSTER (.....) of Holstein, a German, whom Peter I. of Russia took into his service at Hamburg. He was employed in the construction of Cronstodt, Cronstadt, and the Imperial Palace, with many other edifices; and, by order of the empress Catherine, built the palace at Sarskoe-Muisa, now called Sarskoe-sielo. He continued his services till the reign of Elizabeth, and was appointed by her to superintend the construction of several edifices at Cronstadt. He died at a very advanced age in 1747; STAEBLIN, *Anecdotes*, 8vo., Lond., 1788, p. 210, 418.

FOGGINI (GIOVANNI BATTISTA), was born 1652 according to GRANDJEAN and FAMIN, *Archit. Toscane*, fol., Paris, 1846, who notice that he designed the grand staircase of the palazzo Medici afterwards Riccardi and now del Governo, in the via Larga at Florence, in which city he designed the palazzo Chierici in the borgo Pinti; modernised 1693 the large palazzo Viviano della Robbia; designed 1695 the Magazzino dell' Abbondanza; the church of S. Francesco consecrated 1704; and 1703 the church (a door is given in RUGGIERI, *Scelta*, fol., Florence, 1775, i, pl. 69) of the nunnery of Sta. Maria di Candelieri converted 1812 into the *liceo reale*. FANTOZZI, *Guida di Firenze*, 8vo., 1842.

FOGGINTOR QUARRIES. These quarries are situate on the west side of Dartmoor in Devonshire, from whence the granite is taken to Plymouth by railway. The mode of working this quarry was described by W. Johnson in a paper read at the British Association (before 1851). Blocks weighing 20 tons containing about 250 cubic ft. have been frequently obtained. He describes the granite as the best in this country for steps, plinths, strings, blocking courses, ashlars, pedestals, obelisks, columns, cornices, and indeed all other purposes of architecture. It is also very peculiarly fitted for the massive works of hydraulic engineering, as in docks and harbours, on account of the great size in which the blocks may be procured. It has thus been used for copings and mooring posts, for the hollow quoins and projecting quoins of dock and lock gates, for the altars or retreating benches of graving docks, as well as for the heaviest and most massive parts of bridges and other engineering works. The Devonport dockyard; the new graving dock at Woolwich; Tenby beacon in Pembrokeshire; the Neale memorial in the New Forest, Hampshire; the Nelson column; the retaining walls in Trafalgar-square; the Sun Assurance Office, and the Alliance Assurance Office, all furnish examples of the use of this granite; BUILDER *Journal*, 1851, ix, 588.

The above description may be open to some qualifications, as this granite contains a felspar with an excess of soda which decomposes in the air, especially when exposed to the action of water containing carbonic acid gas; the deposits of kaolin clay near Dartmoor prove the facility of the decomposition of this granite.

FOIL (Fr. *lobe*). The term has superseded the words 'feathering' and 'lobe', for each of the semicircular, pointed, or ogee arches which are obtained between cusps in mediæval tracery, panelling, etc. The use of crockets instead of cusps to divide the foils occurs in the circles of the spandrels under the parapet to the choir, 1261-4, of the church of S. Urbain at Troyes. RICKMAN, *Attempt*, 8vo., Oxford, 1848, speaks erroneously of the arches as 'cusps'. Half a foil is counted as a complete one in describing anything as trefoiled, quatrefoiled, cinquefoiled, etc. WILLIS, *Remarks*, 8vo., Cambridge, 1855, p. 194-7, appears to have adopted an objectionable mode of nomenclature when he describes the *hanse* or *ulnar* arch which occurs in early English work as a trefoil with a square central foil; and when he terms the trefoil or the quatrefoil combined with the triangle or the square, a "multi-foil with the foils alternately round and angular." This author seems to agree to some extent with RUSKIN, *Stones*, 8vo., Lond.,

1851, i, 129, who, previously to a rather amusing explanation of the shape of foils, says, while attributing the cusp to the weight required at a haunch, that "the true and perfect cusp is single only: but it was probably invented (by the Arabs?) not as a constructive, but a decorative feature, in pure fantasy; and in early northern work it is only the application to the arch of the FOLIATION, so called, of penetrated spaces in stone surfaces, already enough explained in the *Seven Lamps*, iii, 85." WILLIS, as above appears, uses the term multifoil without availing himself of the words quatrefoil, etc.; he considers as the earliest form of foliation to the head of an aperture the trefoil complete (instead of being a foil and two half foils), as it occurs in many German structures and at the triforium at Valence in France; and he gives a multifoil arch as frequent in early German buildings, and a multifoil arch with truncated cusps from the triforium of the church at La Charité sur Loire. Multifoils are called by the French *polylobes*.

FOIL, see DUTCH FOIL.

FOIX (LOUIS DE), called Fox by Spanish writers, is noticed by MILIZIA and most other authors as having carried out part of the Escorial from a design by Barozzio da Vignola: by DE THOU, *Hist.*, fol., Paris, 1606, ii, 413, he is called Ludovicus Foxius, and a Parisian who was the architect of that edifice and the inventor of the water works machine at Toledo. LLAGUNA however denies these employments of Louis, who certainly was in Spain till 1568-9. BERNADAU, *Histoire*, 8vo., Bordeaux, 1839, 514-19, quotes DE LURBE, *Chronique*, to the effect that the present lighthouse, 160 or 170 ft. high, at the mouth of the river Gironde, six miles from Bordeaux, called the tour de Cordouan, was commenced 1584 at the cost of the province by *Louys de Foix, architecte et ingénieur du roy*, and adds that Louis, after being engaged twenty years on its construction, was buried in the tower (where his bust is placed over the door of the chapel on the second floor) which was completed 1610 but subsequently raised, altered, and decorated. As engineer he appears to have constructed 1570 the dam below Bayonne; and to have formed a new mouth to the river Adour at Boucaut-Neuf.

3. 66.

FOLDED FLOOR, see FLOOR.

FOLDING DOOR. A door formed of two or more flaps meeting each other between opposite jambs. DENNIS, *Cities*, 8vo., London, 1848, ii, 363, notices the existence at Chiusi of an almost unique instance of a pair of Etruscan folding doors, each being a slab of travertine 52 ins. high, 18 ins. wide, and 4 ins. thick, and working on its original pivots. The marks in the pavement of several temples show that they had folding doors; as do those at the three doorways of the vestibule with unfluted Ionic columns to the baths at Cnidus, where the doors opened inwards: these doors probably had the rebate formed, or rather substituted, by a fillet upon the leaf that was first closed; such a fillet is imitated in the stone doors of tombs at Aizani and Pessinuntum; and is shown upon the bronze doors of the temple to Remus now at the church of SS. Cosmo e Damiano at Rome, given by DONALDSON, *Ancient Doorways*, 4to., London, 1833, who considers this fillet to be the *rephum* of VIRUVIUS; and of the north side of the north transept in S. Mark's at Venice; *Illustrations*, 1858-9, s. v. Door.

Considering the number of large ecclesiastical structures which had their great doors not really folding, but made in pairs shutting against a post fixed in the centre of the doorway; and taking into account on the other side, the employment of folding gates and doors in palatial edifices; the period of the introduction of the modern use of folding doors except as entrances seems uncertain: for although they are exhibited in the works of many French artists, 'folding doors' and 'balcony doors' are mentioned separately by NEVE, *Dict.*, 1730 (but what he meant by these terms is not perceptible); and GREGORY, *Dict.*, 1806, p. 40, s. v. Architecture, speaks of folding doors as a modern invention.

Folding doors should never be less than sufficient to allow a

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person to pass freely through the space of one flap, say not less than 4 ft. 4 ins.; one flap should be provided with bolts to fix the top and bottom. The meeting stiles are usually rebated: swing folding doors should be only rounded at the meeting stiles, and hung with spring pivot hinges or rising butts. The inconvenience of doors folding back does not exist with the sliding, or rather rolling, doors which allow of being made thick enough not to warp, and have generally superseded those folding doors made of several leaves, each of which required a bolt into the floor and lintel, and was sure to drop from the action of the weight upon the hinges. Sometimes one of the leaves or apparent leaves is fixed so as to make a false folding door; and this is useful where a doorway is required to be narrow on one side of a wall but to look wide on the other.

In most cases sound passes tolerably freely through the closed opening; to obviate this inconvenience the following remedies have been suggested: 1, double doors; 2, a roller blind covered with Croggen's noiseless felt having a thin sheet of lead at the bottom edge, with small rings on each side to work over a vertical iron rod; 3, double woollen curtains, one on each side; *BUILDER Journal*, 1858, xvi, 469. Before 1840, reciprocal or sympathetic folding doors were invented, and received their name from having an arrangement in the floor by means of which the right or left hand door when made to open caused the other to open in the same direction; they appear to have been disused as causing accidents to persons unacquainted with their action. Hill's equilibrium doors, exhibited at the Royal Institute of British Architects, 30 April 1855, and in use at Somerset House, London, the mechanism of which moves in opposite directions, are rather liable to the same objection. Door; FORIS.

FOLDING FLOOR, or FOLD OF A FLOOR, see FLOOR.

FOLDING JOINT. A joint made like a rule-joint or the joint of a hinge.

1.

FOLEY (THOMAS), an ancestor of the present baron Foley, is said to have been one of the Commissioners for Trade and Plantations in the reign of Anne, and was one of the Auditors of the Imprest; he designed a "superb house for himself 1710, with beautiful gardens," at Stoke-Edith in Herefordshire, given in CAMPBELL, *Vitruvius Britannicus*, fol., London, 1715, i, pl. 20. He died 10 December 1737.

FOLIAGE. The representation of natural or conventional vegetation applied as decoration. The varieties of such vegetation have received attention s. v. ACANTHUS and BOTANY, and the details will be further considered s. v. LEAFAGE. It is therefore only necessary to notice that while most phases of architectural style have had their peculiar foliage, in Greek work the stems, etc., form a more important proportion of the design than the leaves. This peculiarity, and its relation to Etruscan, Romanesque, and Early English work, may be readily seen in JONES, *Grammar of Ornament*, fol., Lond., 1857.

FOLIAGED or FOLIATED PILLAR. This term has been indiscriminately applied to a shaft stilted on foliage; to a shaft carrying crowns or wreaths of flowers or foliage or fruit at distances; to a shaft carrying such materials of decoration as festoons at distances; to a shaft having such materials wound spirally around it (Fr. *colonne corolitique*, which has been turned into an absurd word, as carolitique and coloritique, by some printers); to a shaft having its flutes more or less filled with buds, flowers, or leaves (Fr. *colonne ornée*); to a shaft fluted at bottom and covered with foliage above; and to a shaft covered with water leaves (Fr. *colonne feuillée*), or other foliage; of all of which examples may be found in most collections of sculptured Roman antiquities, as in the temple to Jupiter Clitumnus near Foligno, etc.

FOLIATION. This term properly means the use of the FOIL in mediæval tracery. It is sometimes called *feathering*, which might be advantageously restricted to cases where the end of the cusp is ornamented. The error of RICKMAN, *Attempt*, 8vo., Oxford, 1848, in speaking of "points which are

called featherings or foliations, and the smaller arches cusps", need not be further noticed. In circles that have foliation, three, four, or five, divisions with their multiples occur because (as is supposed) centres in those numbers can be found geometrically; but on this point reference may be made to the *BUILDER Journal*, 1851, ix, 702, and to any work on geometry teaching the method of inscribing the different polygons in circles. A dripstone or hoodmold with external foliation occurring at the churches of S. Giovanni Maggiore, and of Sta. Chiara, both at Naples, is shewn in WILLIS, *Remarks*, 8vo., Cambridge, 1835, p. 194-7; and the use of foliation in similar positions on the gable of the south portal of Notre Dame at Paris, and of trefoils between cusps as crockets over the *portail* de la Calende at Rouen, are given by VIOLETT LE DUC, *Dict.*, s. v. Gable. The term 'double foliated' belongs to work where a main foil is divided by cusps into smaller lobes; and 'triple foliated' where the secondary lobes are again subdivided, of which a good example is afforded by the '*porte-orgue*' at Autun cathedral, given in MAILLARD DE CHAMBERE, *Voy. Pitt. en Bourgogne*, fol., Dijon, 1835, ii, 12. Besides the foliation of plate-tracery and bar-tracery, there is a form of the latter which almost demands a separate denomination; it is that in which a whole suite of moldings follows (as is common in First Pointed work) the curves of the foliation.

FOLIGNO. A city in the Papal States. The town, now chiefly consisting of straight streets within boulevards, is said to have been nearly ruined 1831-2 by earthquakes; a piazza has on three of its sides the palazzi governativo, municipale or comunale rebuilt about 1840 with an Ionic order, and capitolare, with private houses and two towers for the great bells. The cathedral, dedicated to S. Feliciano, was enlarged 1139, the façade to the piazza was erected 1201, and the building after being restored by Bramante, who 1456 added the cupola, had the façade toward the episcopal palace erected 1513, and the interior of the choir modernized 1727 with an Ionic order by S. Cipriani; a renovation of the edifice was commenced 1770 by Vanvitelli, the reformation of the building was entrusted to his pupil G. Piermarini, and C. Folchi began 1819 the completion of the work. It is therefore modern in appearance, except the front of the north transept. The capella del SS. Sacramento, otherwise called the coretta, dating about 1550, is attributed to Buonarroti. The elliptical-octagonal baptistery (xiii cent.) is attributed to Lapo. Of the nine churches, the most interesting appear to be those of Sta. Maria, having a nave cylindrically vaulted, the clearstory windows blocked up, and a vestibule of four antique columns; S. Domenico, having a brick Pointed tower, an unfinished west front with a Pointed doorway, a broad nave without aisles and without windows, dwarf transepts, and an eight-sided apse; S. Niccolo, modernized; Sta. Maria Maddalena, having the plan, like that of the church at Le Vene near the city, hexagonal; and le Contesse, having a cupola said to be by Bramante. The other buildings of interest are a large hospital, and a theatre recently (1845) rebuilt by Luigi Fedeli; with the palazzi Barnabò, Candiotti, Gentili-Spinola, Morotti, and Orfini.

Between Foligno and Le Vene are the remains of a temple to Jupiter Clitumnus, now bearing the dedication of S. Salvatore, having spirally fluted columns and others covered with leaves or scales; given by PALLADIO, *Architettura*, lib. iv. At La Schiaggia, between Foligno and Fano, is a bridge called 'il ponte a botte', over the ravine, of one arch 230 ft. from the bottom; above the arch is a cylindrical aperture 65 ft. in diameter: it was designed by Fabri in 1805. RUTHI-GENTILI, *Saggio Storico-artistico della Chiesa*, 1839; WEBB, *Sketches*, 8vo., London, 1848, p. 461.

FOLTE (. . .) designed at Bruxelles 1750 the entrance buildings containing the circular vaulted vestibule and staircase, and the other apartments, now the library; and 1760-70 the new chapel of the musée in the *ancienne cour* in that city.

FOMERELL, see FEMERALL.

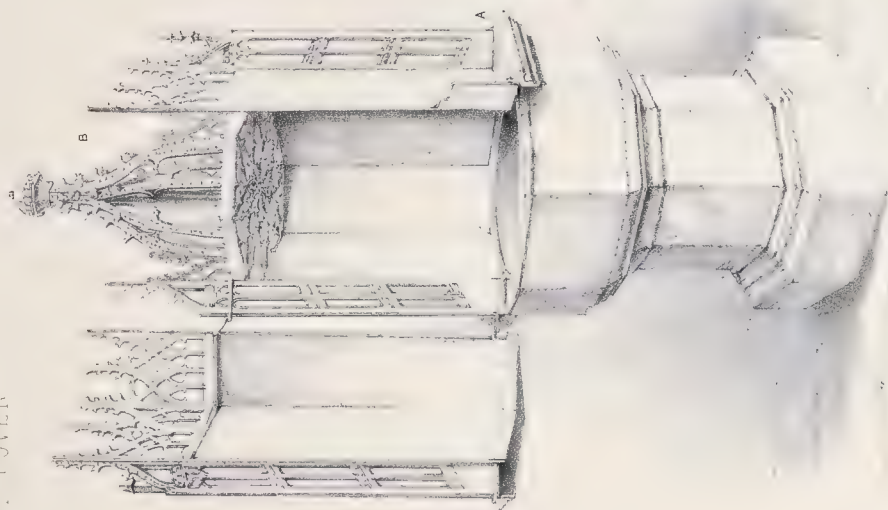
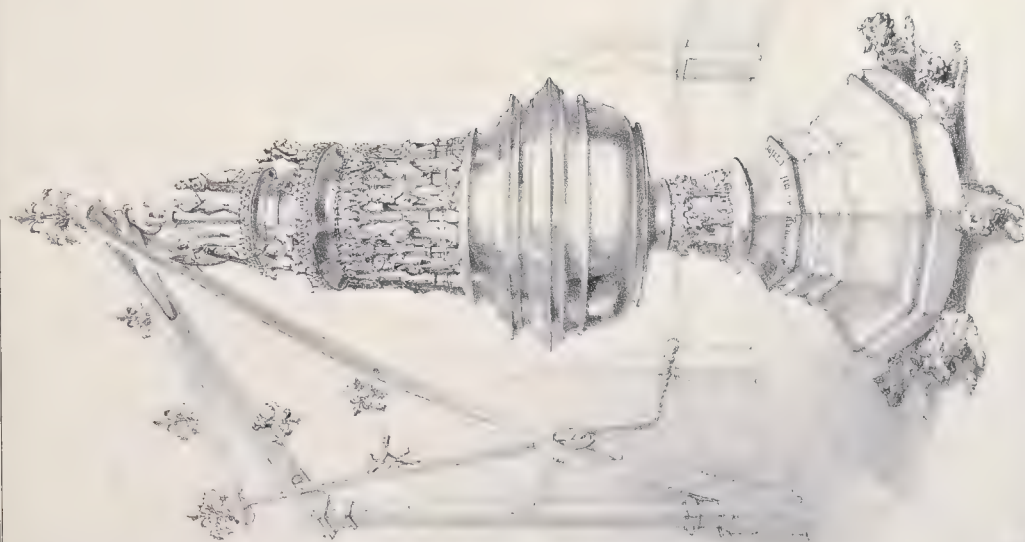
FONSECA (COSIMO) of Brescia, a mistake in SCARAMUCCIA, *Finezze*, for FANSAGA (C.) of Bergamo.

FONT (It. *fonte battesimale*; Sp. *fuenta*, or *pila*, de *bautismo*; Fr. *fonts baptismaux*; Ger. *taufstein*). The vessel which contains the water used in the Sacrament of Baptism. In early times this vessel was called the *baptisterium*, and was placed in an appropriate edifice which received the name of baptistery; and then the reservoir or tank seems to have been called 'PISCINA' as well as 'font'. The basin in the church at Knocking near Oswestry in Shropshire, and that in the crypt of the cathedral at Chartres, both of the Romanesque period, may perhaps be added to the list of such tanks as belong to the buildings mentioned s. v. BAPTISTERY; and a part of the church at Cranbrook in Kent is said to have been reserved for baptism by immersion. The practice of the baptism of infants seems to date from the sixth century, and the standing font would then naturally supersede the tank; the system of total immersion still prevailed, and the dimensions of old fonts consequently vary from about 18 ins. to 24 ins. in diameter, by 12 ins. or more in depth: ROBINSON, *History of Baptism*, 4to., London, 1790, gives details of the manner in which the font was enclosed by a temporary baptistery; and something of this sort, as a permanent but subordinate enclosure may be noticed in the church at Luton, Bedfordshire, where the font is enclosed within an octagonal screen of stone, having its lower part filled, except at the entrance, with panelling, while the upper portion forms a groined canopy. Another enclosure, but of wood, may be found in the church at Trunch in Norfolk. The size of the font naturally lessened after Protestantism adopted the system of baptism by affusion or by sprinkling, of which entries occur at least as early as the ninth century. At Bergen the font is a basin held by the figure of an angel, which is suspended from the roof and lowered as occasion may require.

Standing fonts vary in size (that at East Dereham, Norfolk, 1468, is 7 ft. high), but they were usually about 36 to 40 ins. high, and about 30 ins. wide; they have been made of metal, wood, and stone, besides the artificial material introduced of late years. The font at Canterbury was of silver, as is that at Astracan: the font at Holyrood, removed 1544 to S. Albans, was of brass, as is that at Halle in Belgium, given in the *Illustrations*, 1859, s. v. There are a few fonts made of lead, of Norman date, evidently meant to have a wood or stone pedestal; this metal is used at several churches, of which a list is given in the *Archæological Journal*, 1849, vi, 162; the same material serving for a basin is enclosed by oak panelling at Chobham; and indeed a wooden font seems to be shewn in the same *Journal*, 1856, xiii, 292.

The situation of the standing font has been either in the centre of, or against a pillar of the west end of, the nave, so that the sacrament might be administered in the body of the congregation; or in the south porch; or inside the church, and therefore frequently in the tower, near the principal entrance, and to the left of the entry; or inside the church to the left of the south porch, and consequently generally in an aisle. The form of the standing font has varied in different ages; and in the same age in different districts: the oldest in England is perhaps that at Bridekirk, Cumberland: generally in early Norman work they are round in form, and sometimes less in diameter at bottom than at top; sometimes they have attached shafts, and sometimes the bowl is placed on a round stem, with or without shafts: fonts of late Norman date with square basins, as at North Weston, Portishead, and Portbury, Somersetshire, are uncommon. An octagonal basin occurs in late Norman or perhaps (for if the font be devoid of ornament the style is sometimes an uncertain guide as to date) Early English work, of which last period the circular as well as the square shape is seen. In Second Pointed fonts the square, the hexagonal (as at Heckington, Lincolnshire, and Rowenden, Kent), and the octagonal plans, prevail; but the last only may be said to occur in Third Pointed work.

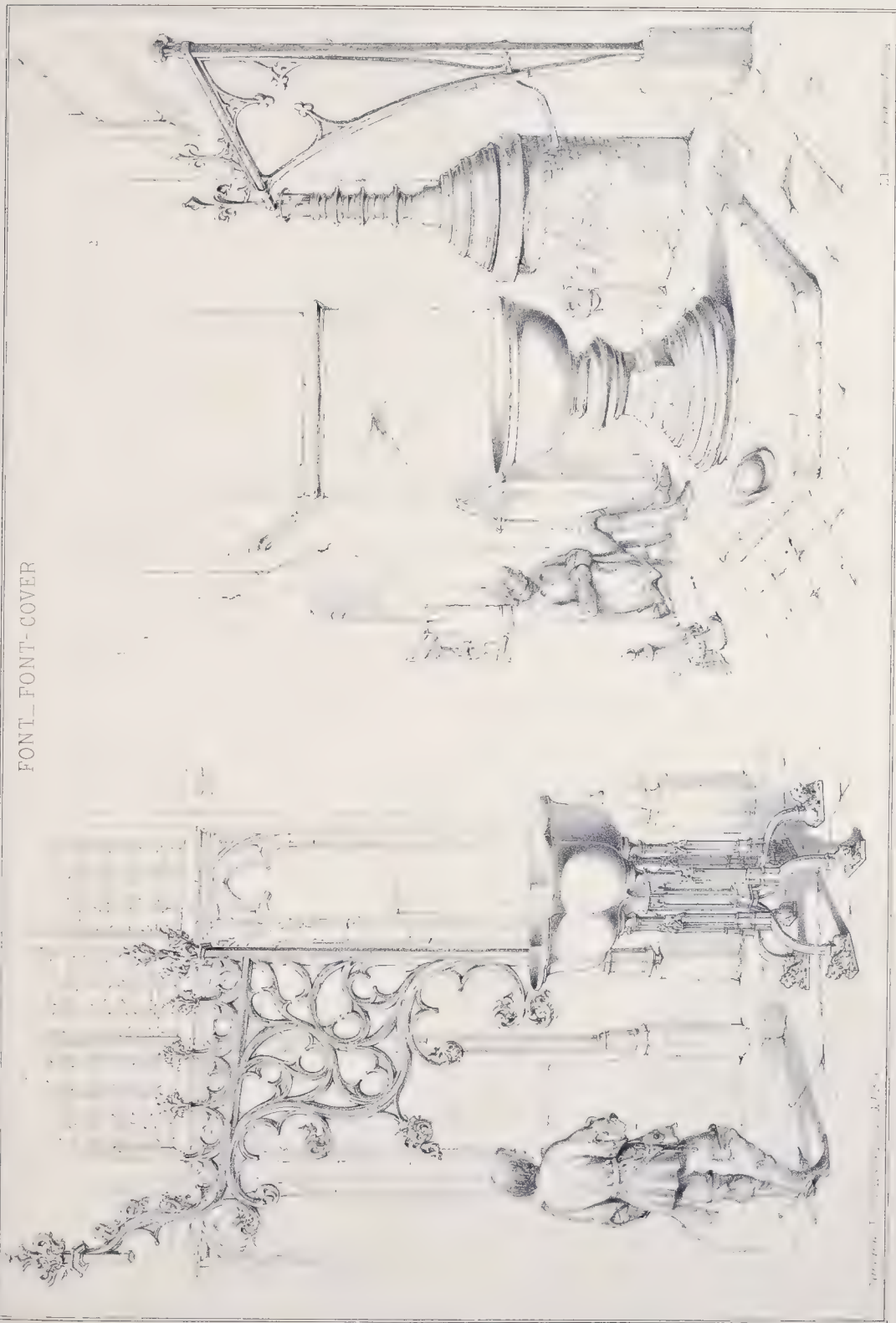
FONT, FONT COVER



SECTION A AND PLAN B



FONT_FONT-COVER





Reference for illustrations of this subject may be made to RICKMAN, *Attempt*, 8vo., 1848, 5th edit.; and to most works relating to mediæval architecture; especially to *Fonts and other Architectural Details from Suabia*, fol., Ulm, n. d.; REPTON, *Specimens of Fonts*, in the *Archæologia* of the Society of Antiquaries, 4to., 1807; SIMPSON, *Series of Ancient Bapt. Fonts*, 8vo., 1828; LEWIS, *Early Fonts of England*, fol., 1843; PALEY, *Illustrations of Bapt. Fonts*, 8vo., 1844; and BATTY, *Some Particulars connected with the History of Bapt. Fonts*, 8vo., Aylesbury, 1848.

FONT COVER. In the thirteenth century the font cover was perhaps merely a lid that could be fastened down with a padlock; but it became exceedingly ornamental during the period of Third Pointed art (to which time only appertain the examples that can be cited, as in the list given in the GLOSSARY, s.v.) in the shape of little roofs and spires. To that list may be added those in the churches at Worstead and North Walsingham in Norfolk, and at Sudbury in Suffolk, given in NEALE, *Churches*, 8vo., London, 1824; of later date are one of Renaissance work in the church of S. Etienne des Tonneliers at Rouen (*Builder Journal*, 1857, xv, 750); and one of Elizabethan work in the church at Sutton, Lincolnshire. Sometimes this cover becomes so heavy that rather powerful mechanical means are requisite to lift and remove it: such a FONT-CRANE in the church of S. Pierre at Louvain is given in GAILHABAUD, *Arch. du V^e Siècle*, 4to., Paris; and in the *Illustrations*, 1859, which also give those in the churches at Halle, and at Leau, in Belgium. A cover, *temp.* Charles II or later, is at Attleborough church, Norfolk.

FONTAINE (PIERRE FRANÇOIS LÉONARD, not Louis, as sometimes printed), born 20 September 1762 at Pontoise, was the grandson of an architect who ultimately chiefly practised as a landscape gardener; and the son of an architect who became a contractor. At sixteen years of age he was taken to L'Île-Adam by his father, who was executing considerable works there under André for the prince de Conti; and thus learnt the details of practice until he was sent to Paris about the end of October 1779 as a pupil of the younger Peyre, who had just received Percier also. In 1785 Heurtier having nominally taken Fontaine as pupil, was thus able to make him one of the *étudiants* in the Academy of Architecture; and the second prize in that year was gained by Fontaine's design for a *sépulture des rois et princes de la famille royale*. He immediately went to Rome, and, after struggling with many difficulties, learnt that a pension had been obtained for him at the same time that Percier, winning the *grand prix*, was sent to that city; together they gave the time not absorbed by academic requirements to the study of modern buildings. Upon their return, besides being engaged on the alteration of the church of S. Joseph for the Section de Brutus, and (under Vignon and Gisors) the hall for the Convention at the Tuileries, and (under Gisors and Lecomte) the hall for the Conseil des Cinq-cents, they found employment in making designs for furniture, paper hangings, silks, etc., especially for the upholsterers Lignereux and Jacob; as Fontaine disliked this occupation he escaped to England, but not obtaining higher work returned to France. Percier, appointed upon Pâris's resignation to the direction of the scenery at the opera in Paris, introduced Fontaine as his partner; and, upon Célérier's disgrace, they were made members of the committee of management for that theatre. Thus brought into connection with people of fashion and wealth, the two architects published *Palais, maisons, et autres édifices modernes dessinés à Rome*, 100 pl., fol., 1798; and, having a large share in the restorations for which the capital at that time afforded ample scope, vigorously enforced uniformity of style with the building in the furniture and other accessories, which they now designed with pleasure. Josephine, being delighted with their work for M. de Chauvelin at the house next to that of Buonaparte in the rue Chantierine, afterwards rue de la Victoire, sent for them early in 1800 to speak about Malmaison;

and at this interview, Fontaine had the opportunity of telling the First Consul that standards were better decorations, for the church of the hôtel des Invalides, than the pictures just received from Italy. The two friends were afterwards employed to carry into execution that idea, and numerous subsequent processions and other ceremonies. Upon Lecomte's disgrace 1800, Fontaine was appointed architect to the Tuileries; and, being able to introduce Percier as his partner, they were entrusted with the works at S. Cloud, Fontainebleau, and the Tuileries, as well as with a chapel in the latter palace. In 1802 they began the rue de Rivoli as part of their design for joining the Tuileries to the Louvre: and shortly afterwards Percier and Fontaine (for such was the title of the firm) fell into such disgrace in consequence of the expense of their alterations of the maison de l'Assomption into an *hospice* for the servants of the palace, that Chaptal, ordered to desire some honest and clever architect to attend Napoleon, was obliged to recommend him to have Fontaine and Percier. Being restored to favour, the great staircase (lately demolished) of the musée at the Louvre, with the staircases at the angles of Perrault's front, were executed by them probably before 1806; by which time Fontaine had obliterated all traces of Lescot's work on the north and south fronts of the court of the Louvre, where he continued the system designed by Perrault for the decoration of the eastern side. In that year the two architects were employed to clear out the space between the Louvre and the Tuileries; to erect the *arc du Carrousel*, finished in 1807, which subsequently obtained the *grand prix décennal* (illustrated in BRËS, *Arc de Triomphe*; and in CLARAC, *Descr. du Louvre*, 8vo., Paris, 1853); to convert the hall where the Convention had sat in the Tuileries into a theatre, completed at the end of 1808; and to restore the palace at Compiègne and at Rambouillet. To this period belongs their *Description des cérémonies et des fêtes, etc., pour le couronnement de Napoléon et Josephine*, 12 pl., fol., 1807, which was followed by their *Description des cérémonies et des fêtes qui ont eu lieu pour le mariage de — Marie Louise*, 13 pl., fol., 1810. As it appears that Fontaine took the external duties while Percier superintended the clerks, the latter should probably have the chief credit of the *Choix des plus célèbres maisons de plaisance de Rome*, etc., 75 pl., fol., 1809-13; and 1824; and of the *Recueil de décorations intérieures*, etc., 72 plates, fol., 1812; and other editions (augmented by LAZZARI and BORSATO, fol., Venice, 1843), which, perfectly exhibiting the 'style de l'Empire', as it was called, gave them an European reputation. They became members of the Institute, in the Académie des Beaux Arts, 1811-12; and were constantly engaged in the preparation of designs for the palace of the king of Rome at Chaillot, the Bibliothèque, a terraced gallery across the courtyard of the Tuileries, the Opéra, the Madeleine, and other works.

Napoleon made Fontaine 1811 *chevalier* of the Legion of Honour, and 1813 *premier architecte de l'empereur*; Louis XVIII made him *officier* of the Legion and *chevalier* of S. Michel, and employed him alone to design and erect the chapel of Louis XVI in the rue d'Anjou S. Honoré, which had the first stone laid 21 January 1815, was finished in five years at a cost of £80,000, and was published by Fontaine, *Chapelle expiatoire*, etc., 6 pl., in NORMAND, *Monumens funéraires*, fol., 1832-6: it is also shown in PUGIN and HEATH, *Paris*, etc., 4to., London, 1831. During the first years of the Restoration the partners had published their designs for the palace of the king of Rome, which forms part of their *Résidences de souverains*, 38 pl., fol., 1833. The text, pp. 291-328, of this work was published separately, and is an amplification of *Le palais royal*, published by Fontaine, 8vo., 1829, as an account of the works, especially the galerie d'Orléans, executed by him there. He had also been employed at Eu and at Neuilly by the duke of Orleans, who, as Louis Philippe, made him *commandeur* in the Legion, and entrusted to him the enlargement 1832-4 of the Tuileries by the suppression of the terrace between the pavillon de l'horloge and the chapel (thus destroying the har-

mony of Delorme's primitive plan), and the works necessary on placing the musée historique in the palace at Versailles. With Lefranc he designed, 1842-3, a chapel dedicated to S. Ferdinand on the site of the house where the duke of Orleans died at Paris (ILLUSTRATED LONDON NEWS, iii, 225), and at the same time the mausoleum of the Orleans family at Dreux in Normandy, *BUILDER Journal*, 1846, iii, 270. Fontaine resigned 1849 the presidency of the Conseil des Bâtiments Civils, and died whilst drawing at his residence in the rue de la Muette near Père la Chaise, 10 October 1853. Dedreux was one of the most successful pupils of the firm; but amongst others were Chatillon, Clochar, Debret, Destouches, and Duquesnoy. Memoir by HALÉVY, in the *BIOG. UNIVERSELLE* (Michaud), 1856, chiefly taken from an autobiography entitled '*Mia Vita*', written 1839-44; *NOUVELLE BIOG. GÉNÉRALE*. 44. 83. 84.

FONTAINE-LE-HENRI STONE, see CAEN, and CALVADOS, STONE.

FONTANA (GIOVANNI), of Vicenza, is supposed to have been the master of Palladio, and was the first architect (1519) of the castello at Udine. MANIAGO, *Storia delle Belle Arti*, 8vo., Udine, 1823, p. 238. 3.

FONTANA (GIOVANNI), the elder brother of Domenico, born about 1540 at Mili near Como, went while young to Rome. He was there engaged on the palazzo of the villa Sforza; and on the palazzo Giustiniani, 1580, the front doorway is by Borromino, *FALDA, Nuovo Teatro*. Assisting his brother in the removal of the obelisk to S. Peter's; and in the works of the loggia, palace, and Scala Santa at the Lateran (where LETAROUILLY, p. 493, ascribes to him rather than to Domenico the fountain at the base of the obelisk); and in the buildings at Monte Cavallo; he succeeded 1585, on the removal of M. da Castello, to the works of the acqua Felice (CASSIO, *Corse dell' Acque*, 4to., Rome, 1756, i, 313). He executed the fountains and fishponds in the papal gardens at Rome, and the aqueduct for the fountains at Civita Vecchia, besides the towers called the Patesio and S. Leonardo on the sea-coast near Terracina, before the accession of Clement VIII, 1592. In that year he undertook, on the departure of his brother Domenico to Naples, the completion of the bridge at Malborghetto, and succeeded to his post of pontifical architect, in which capacity he restored the dam of the river at Tivoli, and executed the cava Clementina, two miles above Terni, for the benefit of the town of Rieti. At that period he directed the supply of water to the villa Aldobrandini at Frascati; and under Paul V, 1605-21, the supply and the fishponds to the villa Mondragone of the cardinal Scipio Borghese (the play of water at both places is given in *FALDA, Fontane*; and the villa Mondragone itself is ascribed to him in *FALDA, Nuovo Teatro*); the supply of the acqua della Fajola to Velletri; of the water from Recanati to Loreto; and of the acqua Paola, on the discovery of the old channel of the Alsietina, from Arco and Baccano to S. Pietro in Montorio at Rome, where he designed 1612 the chateau d'eau and the fountain, both given in *FALDA, Fontane*, who also shows the fountain by him in the piazza di Sta. Maria in Trastevere; and after 1612 he carried that aqueduct over the ponte Sisto to form the other chateau d'eau in front of the Strada Giulia. Having been appointed architect to S. Peter's with his nephew Carlo Maderno, by Clement VIII, the post was confirmed to him by Paul V, in whose reign he built the palazzo Scappucci, near the church of S. Antonio de' Portughesi. In August 1614 he died at Rome of a malignant fever, arising from his visits to Ferrara and Ravenna in consequence of the inundations of the river Po. He was buried in the church of Sta. Maria in Araceli. The works not strictly architectural performed under his direction for the successive popes are noticed by BAGLIONE, *Vite*, 4to., Naples, 1733, 123; and in MILIZIA, *Vite*, 8vo., London, 1822, ii, 87. The church of S. Martino at Siena was probably his work, although attributed to Domenico Fontana. 28.

FONTANA (DOMENICO), born about 1543 at Mili near Como, joined his brother Giovanni at Rome in 1563, as a worker

in stucco. Almost his earliest work in architecture would be the church of the Trinità de' Scozzesi now S. Tommaso degli Inglesi, built 1575 by Fontana and Legenda, according to LETAROUILLY, pl. 180. The cardinal (F. Felice Peretti) di Montalto employed him to build the palazzetto of his vigna near the church of Sta. Maria Maggiore, and (in October 1584) the cappella del Presepio in that basilica. As pope Gregory XIII deprived the cardinal of his income, these works were suspended; but Fontana, being attached to his building and patron, continued the chapel at his own expense. When the cardinal, 14 January 1585, became Sixtus V, Fontana was made pontifical architect; and, with the commission of transferring the old cappelletta del Presepio almost entire into a vault in the centre of the new chapel, completed the above works; and built at the vigna another palazzino (supplying it with water from the acqua Felice) towards the piazza di Termini. When the pope resolved on removing into the piazza di S. Pietro the obelisk that was standing, partly interred, near the old sacristy on the site of the circus of Caligula and Nero, there was a meeting of five hundred competitors from all parts of Italy, at which Fontana exhibited a model of the means he proposed to use for this purpose. Having proved their practicability, and having got rid of G. della Porta and B. Ammanato as supervisors, Fontana was magnificently rewarded for raising 30 April, putting on its carriage 7 May, moving 850 feet and fixing 10 September 1586, with the assistance of his brother Giovanni, this mass, which weighed about 335 tons, but with its casing about 670 tons. In 1587 he removed from the same locality an obelisk to the piazza di Sta. Maria Maggiore; in 1588 another from the circus Maximus (which, as described by LETAROUILLY, p. 481, weighed about 585 tons) to the piazza di S. Giovanni Laterano; and 1589 another from the same locality to the piazza del Popolo. MILIZIA does not notice his employment to level the piazza di Sta. Maria Maggiore, and to open from it the three streets to the Trinità de' Monti, the column of Trajan, and Sta. Croce, as mentioned by BAGLIONE, who adds another street to the porta S. Lorenzo. With his brother Giovanni's assistance, Fontana added the Doric arcade and its Corinthian loggia for the papal benedictions to the front of the church of S. Giovanni Laterano facing Sta. Maria Maggiore; built 1586-8 on one side of this portico a palace (restored by Poletti 1831-40) for the use of the popes when they celebrate service in that church, removing for that purpose the Scala Santa with the Sanctum Sanctorum, and adding the staircases to it (LETAROUILLY, pl. 57, 224, 229); and besides building a great deal to complete the papal palace commenced 1574 on Monte Cavallo, he added the portion towards the piazza and the via del Quirinale or di Porta Pia. He likewise enlarged the piazza and removed to it from the baths of Constantine the two colossal horses; he designed the four fountains at the crossing of the Strada Felice by the via di Porta Pia; and there also built the palazzo Mattei, afterwards Massimi, internally altered before 1672, and now Albani, called the palazzo Nerli in FERRERIO, *Palazzi*. Before building 1588 the palace (and designing the fountain, if this was not by Giovanni, as noted by LETAROUILLY, pl. 225) at the Lateran, however, Fontana had carried a room across the cortile del Belvedere (by Bramante) at the Vatican for the library; and had commenced that part of the palace which faces Sta. Anna and the piazza di S. Pietro, but which was finished by Clement VIII, who raised it from three stories to five in height: the secret staircase from the sacristy of the palace to the cappella Gregoriana was also by Fontana. He restored the column of Antonine and of Trajan, putting on them respectively the statues of S. Paul and S. Peter; and executed the spedale de' Mendicanti, afterwards the convitto de' Sacerdoti and church of S. Francesco, at the ponte Sisto; as well as the doorway, and the gilt ceiling in the sala grande, of the Cancelleria, 1589. According to BAGLIONE and MILIZIA, he executed the aqueduct of the acqua Felice or Sistina, which other writers state was the work of his brother Giovanni, but

which may have had its conduit (LETAROUILLY, pl. 231) in the piazza di Sta. Susanna a Termini designed by Domenico. He made a design for the conversion of the Colosseum into a woollen manufactory, which was stopped by the death of his patron. Fontana's vigna di Sisto V, afterwards Savelli-Peretti, Montalto and Negroni, with its palazzo and palazzetto, is given in FALDA, *Giardini*, 13, 14, who in the *Fontane* shows his fountains and fishpond at the villa; and his fountains at S. Giovanni Laterano, at the porta del Popolo, at Monte Cavallo, and at the ponte Sisto, with the castello or chateau d'eau at the piazza di Termini. The palazzo Nerli at the Quattro Fontane, with the palazzi at Monte Cavallo and at the Lateran, are given in FERRERIO, *Palazzi*; the stairs and doorway of the Trinità de' Monti, and the Scala Santa at the Lateran, are given in FALDA, *Nuovo Teatro*. The cappella del Presepio is given in ROSSI, *Altari*, pl. 42. The front of the university at Fermo was so much altered by him 1585-92 as to be considered his design. Under Clement VIII reverses attended Fontana who, while occupied upon a bridge of four arches over the river Tiber at Malborghetto, was deprived of his post as pontifical architect under pretence of some malversation. He therefore left the completion of the bridge to his brother, and went 1592 to Naples, and after penning up in three channels the waters which had inundated the country between Nola and Patria, renewing the bed of the river Clanio or Lagno; and conducting a water supply from Sarno to the Torre della Nunziata for the use of the mills at Naples; he commenced the strada di Chiaja, putting its fountains therein; aligned the strada di Sta. Lucia; levelled the piazza di Castel Nuovo, erecting therein the fontana Medina; and 1596 built the granary on the sea-shore near the piazza del Mandracchio. Besides the haven and mole, left unfinished by him but continued on his design by F. Picchiati, to the Torre di S. Vincenzo; he designed the royal palace at Naples, but the hall and staircase were completely altered about 1648-50. He published with his portrait *Della Trasportazione dell' Obelisco Vaticano*, fol., Rome, 1590, of which a portion is contained in ZABAGLIA, *Contignationes ac Pontes*, fol., Rome, 1743, but the most valuable edition is that of Naples, 1603, as it includes several plates of the buildings above mentioned; but which, having been published as a memorial of the works executed under Sixtus V, mentions several undertakings in which Fontana may have had no share although some of them are included in the above list on the authority of his earliest biographers. Domenico, who had the title of cavalier, was master of B. Breccioli, of Girolamo Rainaldi, and of Carlo Maderno, who was also his nephew. The church of S. Martino at Siena appears to be the work of a Giovanni Fontana, although attributed to Domenico. Dying in 1607, he was buried at Naples, in the church of Sta. Anna de' Lombardi, in a chapel built by himself, where a monument was erected by his son SEBASTIANO GIULIO CESARE, who succeeded him as royal architect, and designed several buildings at Naples, inclusive of the university, now called palazzo de' Studi, commenced 1599; and the public granaries near the porta d'Alba or Scioscella, 1608, afterwards enlarged.

3. 28. 32. 33. 54. 95. 111.

FONTANA (CARLO), who is supposed not to have been related to the above-named architects, although called in FALDA, *Nuovo Splendore*, the cavaliere Fontana il Giovane, was born 1634 at Bruciato near Como; and went to Rome, where he became assistant to Bernini. MILIZIA says that the churches built by C. Rainaldi in the piazza del Popolo were completed by Bernini and Fontana; and the latter certainly did publish 1674 a design for a spheroidal dome to the elliptical church of Sta. Maria del Monte Santo. Upon leaving his master, he designed the Ginetti chapel in the church of S. Andrea della Valle, and the Cibo chapel in that of the Madonna del Popolo (both are given in ROSSI, *Altari*, pl. 4-5, 38-9); the church of the nunnery of Sta. Marta opposite the collegio Romano; the front of the church of S. Biagio and the Beata Rita at the foot

of the stairs of the Campidoglio, 1655-67 (FALDA, *Nuovo Splendore*); the addition of the aqueduct, with G. B. Contini, from the lago di Bracciano to the acqua Paola, and the supply from it to the Vatican and to the via di S. Pancrazio, 1674; the front of the church of S. Marcello in the Corso, 1683 (ROSSI, *Chiese*); the tomb of Christina of Sweden in S. Peter's, 1689; the palazzo Grimani in the strada Rosella; the palazzo Bigazzini, afterwards Bolognetti, now Torlonia, FERRERIO, *Palazzi* (PASCOLI states that it was his best work, and brought him commissions for the restoration and decoration of several other private edifices); and the restoration, according to FALDA, *Fontane*, of the fountain by G. Fontana in the piazza di Sta. Maria in Trastevere, to which MILIZIA adds another in the piazza of S. Peter's, towards the porta de' Cavalleggieri. PASCOLI mentions also the mills near the church of S. Pietro in Montorio; the cappella dell' Assunta in the collegio Clementino (shown in ROSSI, *Altari*, pl. 40); the front of the church of Sta. Faustina and Sta. Giovita de' Bresciani (in FALDA, *Nuovo Splendore*); as well as the church of the Spirito Santo de' Napolitani, but this building was only repaired by Fontana according to MILIZIA, who attributes the front to Fansaga, by whom the repairs were executed according to other authorities. The completion of the cathedral at Bergamo, long after the death of A. Averlino, is attributed to this architect; who furnished 1682-3 the designs for the college and church of the Jesuits at S. Ignacio de Loyola near Azpeitia in the province of Guipuzcoa in Spain, which were still in progress of execution 1730 under Ignacio de Ibero. PASCOLI states that besides the above works, Fontana had designed the Tordinona and Contestabile theatres; had executed the cupola of the duomo at Montefiascone; had designed the casino Visconte and arranged (*ordinò*) the villa Visconti at Frascati; and had been much employed by the cavalier Acciajuoli before 1690. He was made cavaliere dell' Ordine di Cristo: and, on the death of M. de' Rossi in 1695, pontifical architect by Innocent XII (1691-1700), for whom he executed the church of S. Michele a Ripagrande; the baptistery-chapel at S. Peter's, and the entrance, campanile, and cortile (FALDA, *Nuovo Teatro*) in completion of the palazzo della Curia Innocentiana or della Camera Apostolica, on Monte Citorio. His design for working up the ruins of the temple to M. Aurelius Antoninus into the dogana di Terra in the piazza di Pietra (FALDA, *Nuovo Teatro*) was executed by his son Francesco; his design for the works of the duomo at Frascati was superintended by his nephew Girolamo; and his designs for the mole at Anzio and the aqueduct to Civita Vecchia were carried out by others for this pope, after whose death Fontana completed his patron's tomb in S. Peter's, the unfinished works for the cardinal Guastaldi to the church and the front of the nunnery of Sta. Margarita in Trastevere (FALDA, *Nuovo Splendore*), and the modernization and fountain of the palazzo Massimi at the foot of the Campidoglio. He then entered the service of Clement XI (1700-21); and erected the granaries in the piazza di Termini; the portico of the church of Sta. Maria in Trastevere; the cappella della Casa (Santa?) in the church of SS. Fabiano and Sebastiano; and the basin of the fountain at S. Pietro in Montorio; besides restoring the casino di Pio IV at the Vatican. To these works MILIZIA adds the biblioteca Casanatense in the Dominican monastery of Sta. Maria sopra Minerva; and LETAROUILLY the ospizio di S. Michele a Ripagrande, 1686, as well as the harbour there, 1693, both in conjunction with M. de' Rossi; and TITI, *Ammaestramento*, 18mo., Rome, 1686, notices a chapel on the right hand in the church of S. Francesco a Ripagrande as the work of a Fontana. Besides completing the church of the SS. Appostoli designed by his son, he made a model for the cathedral at Fulda, and sent a design for the imperial coachhouses and stables to the emperor Leopold: he designed 1705 the catafalque of that sovereign in the church of Sta. Maria dell' Anima, and in the following year that of Peter II of Portugal in the church of S. Antonio; both at Rome. In 1705 the

palazzo Gino-Capponi in the via S. Sebastiano at Florence was executed from his design by Ruggieri and Cecchini according to FANTOZZI, *Guida*, 8vo., Florence, 1842, 393, who, p. 461, attributes to him the palazzo Panciatichi, 1650-70, in the via Larga there. GAUTHIER, *Edifices*, fol., Paris, 1830, pl. 16, says that the staircases in the palazzo Marcello-Durazzo at Genoa were by this architect.

Fontana is said by PASCOLI to have written on the subjects of the aqueduct from Bracciano, the aqua Trajana, and Toscana antica; to which DE' BONI adds *Descrizione della cappella del fonte battesimale nella basilica Vaticana*: he certainly published *Il tempio Vaticano e sua origine con gli edifici più cospicui e moderni fatte dentro e fuori di esso*, fol., 1694, written to refute the idea of danger to the cupola, and containing his own magnificent project for the neighbourhood of the church; *Discorso sopra il Monte Citorio*, fol., 1694; *Discorso sopra le cause delle inondazioni del Tevere*, fol., 1696; *Utilissimo trattato dell'acque correnti*, fol., 1696; *Antio e sue antichità*, 4to., 1710; *Discorso—circa il ponte della Badia*, 4to., 1711; and *L'Anfiteatro Flavio*, a folio which was published at the Hague 1725. He died 6 February 1714, and was buried in the church of S. Lorenzo a' Pantani at Rome. PASCOLI, *Vite Moderne*, 4to., Rome, 1730-2, counts amongst his pupils S. F. del Lino, R. Carapicchia, C. Biazaccheri, C. Buratti, T. Mattei, A. Specchi, and M. Sassi; MILIZIA adds S. Cipriani, F. da Accumoli, and F. Ivvara. He had a son, Francesco, and two nephews, Girolamo and Carlo Stefano, sons of a brother who was also an architect but whose name and works are not known. 3. 32. 42. 66. 111.

The royal library at Windsor contains drawings and reports by these architects, filling the greater part of many volumes, among which are those for the alterations at the Lateran; the powder mills at Tivoli; alterations at the villa Giulia and villa Medici; a new sacristy at S. Peter's, including all the apartments, etc., for holding a conclave at the election of pope; the altar of the Beata Giuliana in the church of S. Marcello; the theatres Alibert, Tordinona, and Gaetani; the Santa Trinità di Monti; the Curia Nuova; the monastery of the Phillipines; the chair said to have been that of S. Peter (very curious report with figured drawings); the obelisk found in the Ludovisi gardens, with designs for setting up the same and surrounding it with fountains; the method of moving the great Tazza; the new front of Sta. Maria in Trastevere; the arsenals at Civita Vecchia; the funeral chapels to the memory of Peter II, king of Portugal, and the queen Christina of Sweden; the original drawing and report as to the ponte della Badia; the granaries on the site of the thermæ of Diocletian; the depository of Innocent XII; works at the Propaganda (probably in conjunction with Borromini); the church of Sta. Maria in Monticelli; the fountains in the belvedere in the Vatican; stables in the fortified part of Caprarola; the baptistery and font at S. Peter's; the enlargement of the hospital of S. Michele in Ripa; the illustrated report on the cupola of S. Peter's; the tower of defence at Terracina (much like the martello towers; report on the injuries done to the tambour of the dome at S. Peter's by lightning; a very curious set of designs for prisons at S. Michele, which are exactly like the galleries of inspection in modern houses of correction; a short history of Como "da Cav. Carlo Fontana, cittadino Comasco"; together with other designs by him, which give a very high idea of his genius, and knowledge of construction. A. A.

FONTANA (FRANCESCO), the son of Carlo, though stated by DE' BONI to be a descendant of D. Fontana, was born 1673. He assisted his father at Rome in the execution of the dogana, 1691-1700, and in the restoration of the casino di Pio IV, after 1700; executed at Ravenna a church, with the palazzo Spreti; completed at Castello his own casino; and at Rome the church of S. Luigi de' Francesi; and 1705 the ceiling, if not the interior, of the church of S. Pietro in Vincoli: the execution of his design for rebuilding (except the façade by B. Pintelli) the church of the SS. Apostoli, of which

the first stone had been laid by the pope 27 February 1702, was completed by his father, and the church was consecrated 1724; LETAROUILLY, pl. 167, gives the plan. He died 3 July 1708. 42. 111.

His son MAURO made a design for some portion of the church of Sta. Maria in Vallicella. 42. 111.

FONTANA (GIROLAMO), a nephew of CARLO, died young, but had executed at Frascati the front of the duomo, and the fountain in the piazza. His brother, CARLO STEFANO, as an amateur, designed the decorations of the church of S. Clemente at Rome, the front and cloister to that of S. Eusebio, and several works inside and outside that city. 42.

FONTANA DA ACCUMOLI, see ACCUMOLI.

FONTANELLA, see BIGALO or BIGALLO (F.).

FONTANIL, see GRENOBLE STONE.

FONTE (J. DELLA), see QUERCIA (JACOPO DELLA).

FONTENAY, see CALVADOS STONE.

FOOT. The lower end of anything that seems to rest upon that end, such as the foot of a post, of a rafter, of stairs, etc.

FOOT. A measure of length. It takes its name from the member of the human body, from which the length was originally derived, as shewn by the Gr. *πους*; Lat. *pes*; It. *piede*; Fr. *pied*; and to some extent by the Ger. *schuh*. An Act of Parliament of uncertain period, though dates such as 33 Edward I, and 17 Edward II, have been given to it, entitled 'De Admensuratione Terræ', says that the iron (*i. e.* standard) ell contains three feet, and that each foot contains twelve thumbs. It is usual to add to this Act a memorandum called the 'Compositio Unarum et Perticarum', which probably does not belong to it; wherein it is said of the foot, in these words only, that three grains of barley, dry and round, make one thumb, that twelve thumbs make a foot, and that three feet make an ell; *Statutes at Large*, fol., London, 1810, i, 206. The length of that foot in inches of the present standard has not been determined, but probably it has not much varied from the time of the Plantagenets to the present day. The legal foot, of twelve inches, being the third part of a yard, according to the Act 5 George IV, cap. 74, is determined by the standard yards approved by the Act 18 and 19 Victoria, cap. 72: the standard which ought to have served as a model for them, but which was destroyed in the conflagration of the Houses of Parliament, is supposed to have been $\frac{1}{12}$ of an inch longer than the old one of the country. This variation would of course alter the ratio between the English foot and any other: and no attempt will be made in this article to perpetuate old calculations of the English length corresponding to foreign foot measures; such tables may be found in WOOLHOUSE, *Weights and Measures*, 12mo., London, n. d.; in WATERSTON, *Manual*, 8vo., 1840; and *Cyclopædia*, 8vo., Edinburgh, 1847; and ALEXANDER, *Univ. Dict. of Weights*, etc., 8vo., Baltimore, 1850.

According to a manuscript (fourteenth century) from the monastery of Christchurch at Canterbury, Mus. Brit., *Cotton. MS.*, Galba, E, iv, fol. 21 b, the foot consisted at that time of four palms, each palm being thrice the thickness of the thumb at the root of the nail. AGRICOLA, *De Mensuris*, fol., Basle, 1550, p. 24, says that in his time the French workmen commonly measured a foot with their clenched fists connected by the extended thumbs. The complete scale of the sixteenth century gives the breadth of four barleycorns as a digit, which quadrupled made a palm, and four palms made a foot; five feet being a pace, ten feet a perch, and 5,000 ft. an Italian mile. According to CLAVIUS, *Commentary on SACROBOSCO*, 4to., Leyden, 1593, this was a scale adopted by geometers to avoid the diversities of popular measures. This geometric foot, however, does not seem to have been more than 10 ins. of the present scale according to FERNEL, *Monalosphærium*, fol., Paris, 1526; indeed BLUNDEVILLE, *Exercises*, 4to., Lond., 1597, p. 183, says that the German foot was only 9½ ins. long. No theory of proportions in the design of buildings can at present

be satisfactorily based by any writer upon dimensions which have not been taken by himself with an instrument corresponding to the measure with which the edifices were constructed: with regard to the difficulty which he would experience in translating dimensions given by previous writers, it may be observed that the sixteenth century appears to have sometimes used a foot of ten of our present inches; that Italian and German writers frequently use a local foot without notice to their reader of its value; and that many French authors employed the *piéd* of the *système usuel*, which lasted 1812-40 and, being a third of the *metre*, was about a sixth of an English inch longer than the *piéd du roi*.

Recent calculations of the value of the Greek and Roman foot will be found in PENROSE, *Investigation*, fol., London, 1851, 91, who, referring to the ancient Roman foot, gives the length of a well preserved bronze hinged foot rule in the museum of the Collegio Romano as 0.9728; and of another, not so well preserved, in the library at the Vatican as 0.9664; from three rules sculptured in relief on tombs called the Capponian, the Æbutian, and the Statilian, he obtained respectively 0.967, 0.976, and 0.972; from which, with many other data, he deduces 0.972 English inches as the probable value of the old Roman foot, but does not appear to have given his attention to the hinged foot rule found at Pompeii; R. MUSSO BORRONICO, 4to., Naples, 1830, vi, pl. 15. PLINY and other writers have transmitted the fact that the Roman foot was $\frac{1}{3}$ shorter than the common Greek foot. The Philæterian Greek foot was $\frac{1}{2}$ longer than the Roman foot. Such Roman rules as have been found had been divided into sixteen digits or dactyls, and some of them also into twelve pollices or uncies, but none have the uncial without the digital division. 14.

The register of Newstead abbey is represented to say "Notandum est, quod pes foreste, usitatus tempore Ric. Oysell in arrentatione vastorum, factus est signatus et sculptus in pariete cancellæ ecclesiæ de Edwynstone, et in ecclesiâ Beatæ Mariæ de Nottingham: et dictus pes continet in longitudine octodecem pollices", etc. But upon inquiry of Mr. T. C. Hine lately, it appears that the marks in both places have been obliterated. No mediæval measuring rule except the following has come to the knowledge of the writer. In 1856 a chapel placed at the south-west angle of the tower of Yeovil church, Somersetshire, was pulled down, which left the two buttresses at the angle of the tower of an irregular shape, necessitating their reconstruction; in the course of removing the stones, at the height of about 6 ft., a gauge or rule, together with an iron spoon, were found in an interstice. The rule is of oak, about 1 in. wide and $\frac{3}{8}$ thick: it broke with its own weight; and the centre part, consisting of a few inches, fell to pieces; the original length was apparently 24 ins., 19 of which still remain. Each inch is rudely marked by a thin line cut with a knife or chisel only on one side without numbering. The edge of the rule is curved about two inches in its length, and the inches would appear to have been of the same length as those at present used, although six of its inches make one-eighth of an inch less than usual. It is now in the possession of Mr. R. H. Shout, who superintended the rebuilding, and who attributes the date of the tower to the early part of the latter half of the fourteenth century; from the position in which it was found, he conceives that the rule must have been left in the work during its progress. The two foot measure is mentioned in BENESE, *A Treatise of Measuring Land*, etc., 16mo., London, cir. 1535; and in WORSOP, *A Discoverie of Sundrie Errours*, etc., 4to., London, 1582. YARD; PERCH; ROD; RULE, etc.

FOOTING BEAM and FOOTING DORMANT. Provincial names for the tie-beam of a roof. 1. 2.

FOOTING OF A WALL. The projecting first or lowest courses of stone or brick, at the bottom of a wall, which are intended, by providing a substantial base, to prevent the wall from cutting into the foundation, and from slipping or sliding

upon it. When stone is used for the footing, it should be laid in large sizes of even thickness in level beds throughout each course. When brickwork is used, the intention of the footing is often frustrated by the introduction of inferior bricks, and even of bats, drowned in mortar. PASLEY, *Limes*, etc., 8vo., London, 1836, 266, and App. 32, speaking of some presumed failures in government works, observes that care must be taken, in commencing the brick footings of a building on a concrete foundation, not only to use cement, mortar, and hoop iron bond, in order to do away with the necessity of the more expensive expedients of Yorkshire landing stones and chain timbers, but also to construct inverted arches under all the proposed openings for doors and windows, in order to equalize the pressure. It may be mentioned that the footing courses of the pillars of Lincoln cathedral have so much projection that they extend laterally until they meet those of the side aisles; PENROSE, in *Memoirs*, etc., read at meeting of Archaeological Institute held at Lincoln 1848, 8vo., London, 1850, p. 133. The footings of the cathedral at Amiens are given by VIOLETT LE DUC, *Dict.*, s. v. Construction, 176. Footings should never be less, it is said, than 5 ft. below the surface in CLAY lands, and no drain should be laid below the level of them; consequently the necessary precautions must be taken to prevent, above a certain height in the walls, the rise of damp from land springs or other causes. EARTHWORK; FOUNDATION.

FOOT LACEINGS to settings off, "ought to be considered as straight molding; the bricks to be paid for at a halfpenny per brick, and the workmanship at 1s. 4d. per superficial foot"; LANGLEY, *London Prices*, 8vo., London, 1750, 297; 'Common footlace' is a term inserted under 'Rubbed and Gauged work' in the PRICE BOOK of 1810; but what is meant by the term is not clear, unless a chamfered set off is intended.

FOOT PACE. This term, which appears under the date 1632 in connection with other words which render the sense ambiguous, as "the making of all mantle-trees, tassels, and foote-paces of timber", according to JUPP, *Carpenters' Company*, 8vo., London, 1848, p. 300, is explained as the *haut-pas*, the raised floor or dais at the upper end of a dining hall by WILLSON in PUGIN, *Specimens*, 4to., London, 1822, on the authority of a "fayr foot pace on the higher end" of that at Richmond.

NEVE, *Dict.*, 1703, says that "footpace, or as some call it, half-pace, is a part of a pair of stairs whereon, after four or six steps, you arrive to a broad place where you may take two or three paces before you ascend another step." The term is now confined to the whole landing at the head of one flight and bottom of another flight of stairs; QUARTER PACE being used for a landing of half that width.

FOOT STALL. This, which is certainly an old term, looks like a connection of the It. *pièdistallo*, and the Fr. *piéd d'estail*. WILLIS, *Arch. Nomenclature*, 4to., Cambridge, 1844, seems to overlook the word 'thumbstall', for something into which the thumb is put, and the inference that foot-stall might mean something into which a foot is put, as the excavation for the footing of a pier or pillar. Thus he, quoting JUNIUS, *Nomenclator*, 12mo., London, 1585, p. 203, to the effect that the *patin* or footestal is "that which beareth up a pillar and whereon it standeth on end", i. e. the stylobata (Fr. *pate*, *patin*) of a column; and COTGRAVE, as saying that *patin* is a patten or clog, also the footstall of a pillar, only understands it simply to mean certain blocks, analogous to the pedestal or stylobate of antiquity, placed below the base moldings of a pillar. It is not to be supposed that any belief that the word arose as a contraction of 'foot of the stalls' was intentional on the part of that author, who notices ROUBO, *Art de Menuisier*, fol., Paris, 1769, p. 220, as saying that *patin* meant a sort of plinth three inches high and deep, serving as a base along the extent of any work, as along the front of a range of stalls.

FOOT STONE, see FOUNDATION STONE.

FOOT TABLE. The bottom, and level, stone of a FRAC-TABLE, as the alternately square and curved coping of a gable

of an Elizabethan house, is called by HOLME, *Academy*, etc., fol. Chester, 1688, iii, 472.

FOOT TILE. A tile used in pavements, made 12 ins. square, and so called in contradistinction to others of 10, 8, or 6 ins. square. **PAVING TILE.**

FORAMEN, see **FENESTELLA**.

FORCE (PHILIPPE DE LA), was principal architect to Philip duke of Orleans, ob. 1701, brother of Louis XIV. His son of the same name, who became *ingénieur du roi*, and architect to the duke, designed the town hall and several façades of houses at Ste. Menesould in Champagne. 5.

FORCE. When power is, or can be, balanced at rest, it seems to be most proper to call it *force*; but to distinguish more precisely the circumstances of its action, it is necessary to employ the simple terms, *weight*, *pressure*, and *stress*, and also the compound terms, force of attraction, force of gravity, cohesive force, centripetal force, centrifugal force, and others of a like nature. Force is immediately comparable with the weight of a quiescent body. Its intensity, direction, and equilibrium, are the proper objects of that part of mechanics called statics, or hydrostatics, and aerostatics, when the body exerting force is fluid.

But when a body is in motion, its power, at every instant, or at any point in its path, is usually termed *momentum* or moving force, or quantity of motion. Momentum, or the force of a moving body, is proportional to the quantity of matter in the body, multiplied by its velocity at that instant when the comparison is made. Its rate of increase and decrease, its direction, and equilibrium, are the proper objects of those parts of mechanics called dynamics and hydrodynamics.

It is further necessary, both for practical and scientific purposes, to have a term to designate that power which is equivalent to momentum, when the velocity is uniform. *Mechanical power* then is a particular name for the momentum of a body in uniform motion; in that case it is proportional to the quantity of matter in motion, multiplied by the length of the line through which it acts; for when the velocity is uniform, the length of the line the body moves over is proportional to the velocity.

Of animal force YOUNG, *Nat. Phil.*, ii, 165, says, "to compare the different estimates of the force of moving powers, it will be convenient to take a unit which may be considered as the mean effect of the labour of an active man working to the greatest possible advantage and without impediment; this will be found, upon a moderate estimation, sufficient to raise 10 pounds 10 ft. in a second, for ten hours in a day; or to raise 100 pounds, which is the weight of 12 wine gallons of water, one foot in a second, or 36,000 ft. in a day, or 3,600,000 pounds, or 432,000 gallons, one foot in a day; this may be called a force of 1, continued 36,000"; BUCHANAN, *Millwork*, etc., 3rd edit., by G. Rennie, 8vo., London, 1841, p. 77-8, 89. **DYNAMICS.**

FORCE or FORCER. A portable pump, acting by a piston like the common syringe, and used for unstopping pipes by plumbers, who attach to one end of a pipe a hose connected with the pump, by which water is forced down the pipe until it is cleared. Franklin's improved plumber's force is described in the *SOCIETY OF ARTS, Transactions*, 1843-4, iv, 43.

FORCE OF THE WIND. The force of the wind is understood by authors upon physics to express the momentum of the action exercised by the wind upon any body exposed to it; this the architect requires to take especially into account in designing buildings of any considerable elevation in unsheltered situations. Wind will, in fact, exercise a tendency to overthrow a building, upon the external edge opposite to the line of its advance, equivalent to the surface of the face receiving the impulsion multiplied by the force of the wind, and by a lever which on the average may be taken to be equal to half the height of the building; and to secure the stability of the latter, its weight multiplied by a lever equal to half the base must exceed the sum of the elements of the wind's action.

Even in England, gales having a force of 64 lbs. on the superficial foot have been observed; and in tropical regions they have exerted a still greater force; it would therefore be safer, in calculating the stability of a chimney or of a steeple, to consider the coefficient of the force of the wind as being 120 lbs. per superficial foot. A cylinder only offers two-thirds of the resistance offered by a flat rectangular body to the action of the wind. SMERATON, *On the Power of Wind and Water*, 4to., 1814; *Annales des Ponts et Chaussées*, 1831. **AERODYNAMICS.**

G. R. B.

On the roofs of buildings in the country where they are exposed to rude gusts and storms, it is necessary to increase the weight on the ridges, hips, and flashings. T. L. D.

The force with which the wind strikes against a quiescent surface may be expressed as the square of the velocity. 23.

FORCEPS, see **FORFEX**.

FORCINUS, Ingeniator, is mentioned by HARTSHORNE, in *Transactions of Royal Inst. of Brit. Architects*, 6th May, 1850, as employed at Colchester castle in the sixth year of king John's reign, 1204. 32.

FORE. A word used as equivalent to 'front', as in fore front; fore ground; and fore part.

FORE CHOIR, see **ANTE CHOIR**.

FORE PLANE. The first of the three planes generally used after the axe or the saw, in giving a smooth face to a board, etc. It is about 18 ins. long and has the iron, which is set rank, ground with a kind of convexity to take off the rough surface before the long plane is applied; the work so treated was said to be dressed. 4.

FORES. The plural, and most usual, form of **FORIS**.

FORESHORTENING. The perspective diminution of the side or part, of a body, caused by the obliquity of its position to the plane of projection. Scales are described in the *SOCIETY OF ARTS, Transactions*, 1833, xlix, pt. ii, 20, as invented by J. D. Hopkins, "for the purpose of facilitating the operation of obtaining, in geometrical foreshortened proportions, any divisions of circles and octagons (and for exhibiting a principle equally applicable to any other figure, either regular or irregular in its form, or whether regularly or irregularly divided) together with the foreshortened faces, and the returns of solids of any width and thickness placed upon the same, either spaced with solids or voids upon the central line of view, and either for the concave or convex side of the same."

FOREST MARBLE. A limestone belonging to the lowest division of the oolitic series raised for local constructions in the Wichwood forest, Oxfordshire; and from the Pickwick and Atford quarries near Bath. The general colour of the stone is grey or bluish, occasionally stained by the oxide of iron; in some cases it appears to be entirely composed of fossil shells, univalves in the thinner, and bivalves in the thicker, beds. The structure is fissile, and the beds rarely attain three feet in thickness. Locally this limestone is used for roofing; and being sometimes susceptible of a polish, and of a rather pleasant effect on account of the number of fossil shells it contains, it is used as a marble; but it is too coarse-grained, and of too unsatisfactory a colour for any distant market. Forest marble is closely connected with the beds known as the Stonesfield slates. CONYEBARE and PHILLIPS, *Geology of England and Wales*, 8vo., 1822. G. R. B.

FOREST OF DEAN STONE, or **DEAN FOREST STONE**. The quarries whence this sandstone is derived are situated at Coleford, Lydney, Bream, and Yorkley, in Gloucestershire. The best stone is raised, but differing very much in value and quality, at 1, Birch hill; 2, Bixlade and Bixhead; 3, Dark hill; 4, Lydbrook (Barnedge); 5, Knockley Lump; 6, Gosty Knoll; 7, Morgan's Cote; 8, Merry Hole. The stone which is generally grey or blue in colour, lies in three series, each of a different degree of hardness, and each applied to peculiar and distinct purposes; but the quality of the stone differs in the various localities. The upper series is generally from 20 to

30 ft. thick, the second 40 to 70 ft.; a thin vein of clay from 3 to 7 ft. intervenes. The third series is proved to 130 ft., but its total depth is unknown; hence where the three series are found, as in the centre of Birch hill, the supply of stone seems inexhaustible. The upper series consists of a soft, easily worked stone, of various degrees of hardness, suited for the manufacture of grindstones, sinks, troughs, gravestones, flagging, sills, and wall coping; all of which, in the best quarries, can be got of any size that can be carried through the arches of the Severn and Wye tramways. The second series consists of a grey stone, of harder character than the first; whilst the third species of stone is of a blue colour, still harder, and of a closer, finer grit; both series afford blocks of any removable size. The stone is well adapted for dock and railway purposes; also for building and statuary, being easily worked and sawn and planed by machinery. If placed on its proper bed, it does not scale, and is not affected by the weather; instances of its durability may be seen at Newland, Staunton, and Mitcheldean churches, in which the outlines and carving of the oldest pinnacle, and the letters cut on the oldest gravestone are as sharp and defined as when first worked, some four hundred years ago; but it must be observed that only the stone raised in certain localities and from the best quarries is likely to possess these qualities, generally so unusual in sandstone. The price of blocks at the quarry is 7d. or 8d. per cubic foot if scappled or picked; and about 7s. per ton if rough; common building stone 1s. per ton; flagging from 2d. to 2½d. per foot superficial.

The stone has lately been used in the construction of Cardiff, Newport, Gloucester, and Swansea docks; South Wales, Taff Vale, and Western Valleys railways; Gloucester and Berkeley canal; Gloucester Over bridge; Folly bridge, interior of S. John's and Exeter colleges, assize courts, and Taylor and Randolph's buildings, all at Oxford; Cardiff castle, and National and Provincial bank; Marlborough, and part of Llandaff, colleges; Eastnor castle and Whitley court, Worcestershire; Langton house, Oxford, in steps 18 ft. long and landings of proportionate size; etc. The towns paved with it are very numerous. *BUILDER Journal*, 1860, xviii, 431, from reports by Mr. Atkinson, engineer, and Mr. Terrett, builder, both of Coleford; also p. 761 of the same volume.

FOREYN. A term occurring in the accounts of building Little Saxham hall, 1505, given in *GAGE, Suffolk*, fol., London, 1838, p. 140-8-9; the foundations to be wrought with 'foreyns' and other necessities, concerning the moat: 'chymneys, foreyns and gutters'; 'foundacions, chymneys, foreyns and batilments'; whence it is supposed to mean either a drain or cesspool. *ROBERT OF GLOUCESTER* terms a cloaca 'forene' or a 'chambre forene'; and *COTGRAVE* explains *forans* to be a sort of reservoir into which sea water is conveyed by pipes. 17.

FORFARSHIRE STONE. Throughout the whole of the county of Forfarshire, stones, obtained principally from the old red sandstone series, are found in abundance, and they are used to a great extent for building purposes, both locally and at a distance. In many instances, however, the intrusion of plutonic rocks, as in the case of the granite mass of Dundee Law, the hills near Monikie, Carmylie, and Montrose, has affected the mechanical structure of the stone to such an extent as to render it unfit for masonry of a monumental character; and under these circumstances the stones obtained from the neighbourhood of Arbroath and of Dundee are nearly the only ones which are known beyond their own immediate localities. At both of these places sandstone quarries are worked on a great scale, producing ashlar and paving stones of large dimensions for exportation; the granite, trap, and amygdaloidal rocks, and the limestones, are exclusively reserved for local use, as rubble masonry, lime burning, or road metal. The Dundee sandstones occur near the town of that name, and they are well adapted for waterworks, bridge building, or other structures in which colour is not a consideration of importance. The upper beds

are generally of a red colour; this gradually passes into purple, and finally into a grey colour; the best stone being of the latter tint. It weighs about 158 lbs. per foot cube, the specific gravity being 2.53; and the resistance to an instantaneous crushing force, according to G. Rennie, is 14,918 lbs. per inch superficial. This stone has been used in some of the docks of London; but its dark colour, and the cost of the labour upon it (which is greater than on Yorkshire stone in the ratio of 1.2 to 1.0), oppose its general introduction in the southern parts of the kingdom.

Arbroath abbey (commenced by William the Lion, 1178, but erected chiefly in the course of the thirteenth century), one of the largest and most interesting ruins in Scotland, was principally constructed of the dark red sandstones of the neighbouring parishes of Carmylie, S. Vigeon's, and Inverkeilor. This stone has resisted the action of the atmosphere with tolerable success; but its deep red colour is very objectionable; and wherever moisture can lodge upon the stone, the surrounding portions, which are likely to take up that moisture by their capillary action, bear evident marks of abnormal decay. The paving stones raised in the parishes of Carmylie, Inverkeilor, and S. Vigeon's, and the freestones used in Arbroath, which are obtained from the same quarries, are, however, more generally known and more extensively used than the red sandstone. They are of a greenish brown colour, analogous to the Yorkshire paving stones and to the Parkspring (ELLAND EDGE); and, indeed, they closely resemble those stones in all their physical qualities, excepting that they are not quite so hard, or so durable under an action of abrasion. The paving stones are raised in the greatest quantities at a place called Leysmill, in the parish of Inverkeilor, and are lifted in thicknesses varying from 2 to 8 ins., and in superficial dimensions from 4 to 50 ft.; the price in Arbroath for the 3-in. paving being about 10s. per 100 ft. Hunter's planing machinery has been successfully applied in their preparation by the late Mr. F. Lindsay Carnegie; and every stone supplied from his quarries was worked at once with a plain rubbed face, instead of being tooled as is usually done with the Yorkshire flagstone. They also present one advantage over the flags sent from Yorkshire, which may go far to compensate for their rather softer nature; viz. that they are much more even in their texture than the latter; and as they appear to be rather worse conductors of heat, they also present some additional advantages for internal use. At equality of price the Yorkshire stone is, however, preferable to that of Arbroath, for the purposes of street paving; and for the purposes of ashlar masonry it is essential to observe, both with the Yorkshire and with the Arbroath sandstones, that they present very distinct planes of bedding, and consequently require to be placed in buildings in positions analogous to those they occupied in the quarries; and that they are exposed, under the action of moisture, to very destructive internal chemical action. It is essential, therefore, to execute plinths, cornices, or other exposed portions of buildings, in the more durable granite, or the millstone grit materials. In the Leysmill quarries, the paving stones are usually found at a depth of about 16 or 18 ft. from the surface; and they occur in layers of between 2 and 6 ft. in thickness, separated from one another by layers of an argillaceous earth of variable depths ranging from 7 ins. to 5 ft. In some instances the quarries have been worked to a total depth of about 70 ft. from the surface, at which level the land waters stop further progress. The ashlar stone quarries appear only to present some local exceptions in the mode of deposit of the sandstones, in consequence of which the material possesses a more homogeneous character than usual with paving stones.

There are some other materials obtained in the county of Forfar, such as the Glamis slates, the Brechin limestones and freestones, the Dunnichen millstone grits, the whinstones and the freestones of the Siedlaw hills, in the parish of Kinnettles, etc.; but their qualities are not such as to justify their use at a

distance from their locality. It is principally on account of the facilities which exist for transporting the Arbroath and Dundee stones to the markets of the south of England which are upon the immediate seaboard, that those stones can be employed with advantage.

C. R. B.

FORFEX. A term used by VITRUVIUS, x, 2, for part of the apparatus by which large stones or other weights were raised. He first directs three beams of timber (*tigna*) to be selected, fit to bear the weight to be raised: they are to be joined together at the top, and spread out (*divaricata*, literally astride) at the bottom; to be erected by ropes tied to their tops; and to be kept up by the same ropes lashed round them; being thus very similar to the triangle in present use: to the top a block or pulley (*trochlea*) is to be tied, which, he says, some call '*re-chamum*': in the block are to be two sheaves (*orbiculi*) turning on small axles (*aziculus*): over the upper sheaf the fall (*ductarius funis*, literally leading rope) is to be passed, again passed under the sheaf of a lower block, brought back to the lower sheaf of the upper block, brought down again, and the end of the fall (*caput funis*) made fast to a hole therein; the other part of the fall is brought down to the lower part of the machine. All this is very much like what sailors call a half watch-tackle, only the sheaves are one below the other and not side by side. VITRUVIUS then directs that on the back of the timbers *chelonis* shall be placed, in which the ends of the windlass (*suculae*) shall be laid so that the axis may easily turn. [ROBT. STEPHENS, *s. v.*, says *chelonis* are bushes (*umbilici*) or handles, query ring-staples (*ansae*), and are so called from *chelonia*, the shell of a turtle; from this and other passages it may be gathered they were the gudgeons or bearings on which the axles of the windlass worked.] VITRUVIUS goes on to say, let the windlass near the heads have double holes, so that the handspikes (*vectes*) may fit therein: to the bottom block let iron 'forfices' be lashed, whose teeth shall fit to perforations in the stone: when the end of the fall shall be secured to the windlass, and this turned by the handspikes, the rope is stretched and the weight raised to its proper height and place. A similar triangle, blocks, and windlass, is in use at this day by the Royal Artillery for raising weights, particularly for setting mortars on their beds; and also by gas companies for laying their pipes.

From this description the meaning is readily obtained of all the technical terms used except that of the iron apparatus. All the copies of VITRUVIUS have 'forfices'. PHILANDER proposed to read 'forpices', but why it is difficult to conceive, for the meaning seems the same as forfex, and forpex is not found in any classic author, and it is believed was first used in the sixteenth century. He then endeavours to prove that the instrument was the 'lewis', which is known to have been used by the Romans from the existence of holes for such an instrument in many stones, and from the fact that they have been dug up at Rome and Pompeii. The Roman lewis is figured by various authors, from PHILANDER to PIRANESI, and also in the Utini edition of VITRUVIUS. PHILANDER calls the lewis *cuneoli*, but there is no authority for the use of such a name. The probability that the lewis is not meant, is the fact that VITRUVIUS says the forfices have teeth; now surely this can scarcely be said of the former. From an analogy with the Greek, the best Lexicon of the day interprets *ψαλς* "a pair of shears, but rather a single edged instrument for shearing, a kind of rasor"; and cites from the Greek ANTHOLOGY, *Cod. Pal.*, xi, 368; and ARISTOPH., *Achar.*, line 849, which in BEKKER'S edition is line 814. But with great submission to so high an authority, the first cited epigram is directed against a man with an inordinate beard, and tells him "it is such a harvest that he needs sickles", *δρεπάνοισι*, instead of *ψαλίδεσσι*, a plural word which seems exactly like our own plural scissors. In the second cited passage, the word *μοιχόν* surely throws too much lurid light on *ἀεὶ μεκαρμένος*, and on *μὴ μαχαίρα*, to suppose it has any allusion to the subject of this article. The word *ψαλς* in other senses means a vault, an

arch, an arched aqueduct. May it not mean in this sense a pair of shears as ordinarily used by shepherds. These are of one piece of metal, and arched at the top. In this case the 'forfex' was probably the iron clip now often used to lift weights, the arms catching in a projection or in a hole in the sides of the weight; or like the clips used in warehouses where boxes and similar articles have to be weighed, the two arms passing under the sides of the article.

A. A.

COCKERELL, in the supplementary volume to STUART, *Antiquities of Athens*, says, "We learn but little of the mechanical means employed by the ancients from the accounts given us by VITRUVIUS and PLINY; the use of the two species of forfices mentioned by the former (the lewis and forceps) is apparent in the ruins of Selinus and other parts of Greece, where the stone was sufficiently hard to receive them; in the ruins of Agrigentum, where the stone was soft, the horse-shoe formed channel on the side was made to receive ropes or chains, which, when the stones were raised to their places and adjusted to their positions, were drawn out of the channels." Various methods are exhibited in pl. 8; and on the next page he observes, "it may here be remarked, that in some of the other temples of Agrigentum, the forfices were used, as well as the method described above."

FORI, see FORUS.

FORIS. One of the Latin names for a door. Had it not been restricted to the door of a sacred edifice (for CICERO, *De Nat. Door.*, ii, 27, says '*fores* in liminibus profanarum ædium januæ nominantur'), the word might seem to supply the deficiency, stated *s. v.* DOOR, of the Latin technical name for a single-hung door: the leaf of a pair of doors is *claustrum* in CLAUDIAN, vii, 92, and in MARTIAL, *Ep.*, x, 28; *foris* in OVID, *Her.*, xii, 150; and *valva* in PETRONIUS, *Sat.*, xcvi, but there is a well known difficulty in accepting the poets as authorities for the technical use of terms; nor does ISIDORUS, *Orig.*, xv, 7, seem trustworthy in saying that '*fores* open outward and *valvæ* inward, but popularly the distinction is not recognized. The *foris* was generally made to turn on pivots formed by the prolongation of the *scapus cardinalis*, the present hanging-style. As part of the text of VITRUVIUS, iv, 6, relating to the proportion of the doorway, is disputed, and as the whole of his instructions for setting out the details of the *foris* itself not only depends upon that proportion, but has been mangled and altered by his editors and commentators (collected in the Udine edition, 4to., 1827) the student is referred to the text and notes in DONALDSON, *Ancient Doorways*, 4to., London, 1833. The credit of seeing that the *replum* was the fillet running as a cover-joint the whole height of the *foris* between the panels is attributed to Bertani (1558) by MARINIO, *Vitr.*, fol., Rome, 1836. The fact that the doorways, even of the chambers, in every building of any importance, contained generally what we usually call folding doors, *i. e.* two doors hung against opposite jambs and meeting each other, was established by the ruins at Pompeii, GELL, *Pompeiana*, 2nd ser., 8vo., London, 1824, i, 166-7. Hence the general use of the word *fores* in the plural for the means of closing a doorway, even to a bedroom, as *fores cubiculi* in SUTONIUS, *Hist. Aug.*, 82; QUINTUS CURTIUS, v, 6; and APULEIUS, *Met.*, ix. All that exists, not undisputed but tolerably clear, upon this subject in VITRUVIUS, seems to be that if the *foris* was not *clathrata*, nor *biforis*, it was to be *valvata*; that if *valvata* it was to have extra width; and that if *quadriforis* it was to have additional height. After determining (on the authority of the specification relating to an ostium at Puteoli, B.C. 105, given by DONALDSON from PIRANESI, *De Magnif. Romanor.*, fol., Rome, 1730, pl. 37, which differs in some respects from other editions of the inscription), that the commentators need not have disturbed *clathrata* in the Vitruvian text, it may be supposed that *foris clathrata* meant a door framed very much like a portullis; that *foris bifora* meant each leaf of a pair of folding doors; that *foris valvata* meant a door with folds like a shutter; and that *quadriforis* meant a

pair of *bifora* cut like shutters into top and bottom doors: but it is difficult to imagine a *foris valcata* with apertures in the exterior parts unless the panels were grated.

The other details of the 'foris' as enumerated by VITRUVIUS, are *scapi cardinales* or hanging stiles; *cardines*, the hinges on which they may be hung; *azes*, the pivot hinges: some authors however invert these last terms; *impages superiores et inferiores* or top and bottom rails; *impages medii* or middle and lock rails; and *cymatia*, moldings round the *tympana* or panels. JANUA; OSTIUM; PORTA; VALVA.

FORLÌ (the Roman Forum Livii). The capital, of the legation of the same name in the Papal States, which has had its buildings extremely damaged by the earthquakes of 1279, 1661, 1778, and 1781. The only remnant of the classic structures is a part of the bridge, useless since 1042, called the *ponte de' Morattini*. The piazza grande, containing the column of the Virgin, 1636-40, and the palazzo governativo or pubblico is considered one of the finest in Italy. The cathedral, dedicated to the Sta. Croce, the Virgin, and S. Valeriano, was rebuilt as a basilica with a portico of the Corinthian order by Giulio Janbianchi of Forlì, whose design was selected by the Accademia di S. Luca from the works submitted in a competition 1840, which contained amongst other regulations the retention of the two cappelle Maggiori: one of these, the cappella della Canonica, is the domed tribune designed by Pace Bombaci and executed by him and his successors Cesare da Carpi, Silvestro de' Sarti, and Cristoforo da Forlì, 1490-1521; the other, called the cappella della Madonna del Fuoco, is eastward of it, and was a continuation of the same design, 1619-35, by Paganelli. Of the seven parish churches, that of Sta. Anna, now called S. Antonio, was consecrated 1819; and that of Sta. Lucia, now called S. Giacomo Maggiore (built for the Paolotti 1614), had its front finished 1829. The Observantine nunnery, finished 1486; the Jesuit college, 1567; the Servites, with a fine chapel dating 1640; the Capucin nunnery, 1653; the church of the Filippini, commenced before 1655; the nunnery of Sta. Febronia (*le Paoline*), and of Sta. Chiara, both dating 1661; with the Franciscan nunnery, 1786, having its church restored and the new buildings completed 1794; were the most important of the twenty-three conventual establishments now reduced to seven monasteries and three convents. The church of S. Mercuriale, belonging to the Vallombrosani, with a brick campanile, 1178-80, by Francesco Deddi, remarkable for external and internal design as well as for height; the chiesa dei poveri della Misericordia, 1772; the episcopal palace, 1260, enlarged 1563-87; the palazzo pubblico, begun 1359, with its portico added 1471, finished 1643-69, and restored 1826; the palazzo del Podestà, dating about 1433-53; the monte di Pietà, 1514; the palazzo Guerini, ascribed to M. A. Buonarroti; the teatro comunale, 1776, enlarged 1809; the front of the ospedale, 1827; and the circus for the game of pallone, 1824; are all the other works that deserve special notice at Forlì. 28. 96.

FORM (Fr. *banc*). A long seat (a long stool, PROMPT. PARV.), frequently movable and formerly made of 1½ in. deal with legs of the same stuff mortised into the seat and braced below, but now most generally with iron legs. Various designs are given in the publications of the Committee of Council on Education; and s. v. DESK. DU CANGE has "forma, a sort of long portable seat called by the French nation at present *forme*." A. A.

The difference between a form and a bench is not clear; perhaps the one is movable, the other fixed; though some authorities consider that a form is a long bench; while others intimate that the latter has a back, which the former has not. 5.

FORM. This word appears to be used in the sense of 'fashion' by old writers: HOLINSHED, *Chronicles*, fol., London, 1586, i, 196, says that at Windsor, queen Elizabeth "appointed huge summes of monie to be employed upon the ornature and alteration of the mould, according to the forme of building used in our daies, which is more for pleasure than for either profit

or safeguard." But it also may have signified 'design'; thus in the contract for works for the church at Bodmin in Cornwall, dated 9 December 1491, given in the *BUILDING NEWS Journal*, 1859, p. 556, mentions "newe chayrs and seges and iiij renges", to be made "after the furme and makyng" of those in S. Mary church, Plympton; and "a convenient pulpyte after the furme and makyng" of that in the church of Moreton in Hemstead, or better.

This term is also used in various indentures, as in the contract for works at Westminster Hall, London, 1395, given in RYMER, *Fœdera*, fol., London, 1709, vii, 794, in the words "une fourme et molde faitz par conseil de Mestre Henri Zeneley." In one of the date of 1440 occurs, 'the edification (of the college)—proceed in large forme, clene, and substantially'; as also 'manner and form' relating to woodwork; 1509, 'maner fourme and fashion' in the erection of a building; 1513, 'forme, maner, goodness, curyosity, and clenelyness' as regards painted glass for windows; and 1543, 'manner, form, fashion, and due proportion' in the building of a cross. FORMPEYS; FORMULA.

FORMA. This late Latin word has three significations; 1, a STALL; 2, a mould, pattern, or template, cut in wood or thin metal, as GERVASE, in 1291, speaks of "formas quoque ad lapides formandos"; and 3, tracery, according to WILLIS, *Arch. Nomencl.*, 4to., Cambridge, 1844, who quotes the Ely Fabric Rolls, 13 Edward III, "i forma vitri in grosso, 24s.", as meaning "a window completely glazed." As the *ENCYCLOPÉDIE MÉTHODIQUE, Arts et Métiers*, fol., Paris, 1791, viii, 687, has *forme de vitres*, that author translates *forma vitri* by *forme de vitres*, supposing that the stone frames of Gothic windows were termed *formes de vitres*, forms or seats for glass; and suggesting that FORMPEYS was therefore the old term for a piece of tracery, and 'formula' its diminutive.

FORMACEUM or FORMARIUM OPUS. PLINY, *H. N.*, xxxv, 48, says, "in Africa and Spain are walls made of earth, which they call 'formacei', because (the materials) are stuffed into a 'forma' made of boards on either side, rather than built up." He describes them as of great durability, and says the watch towers of Hannibal in Spain were in existence in his time. ISIDORUS, *Orig.*, xv, 9, calls such work 'formarium or formatum opus'; and the Spanish word *horma* still means a mud wall. PLINY does not say the Romans built in this manner; but PALLADIUS, *R. R.*, i, 34, says that all "gardens should be enclosed", and that some persons "imitate brick walls by mud (*luto*) enclosed 'in formis', and where the material can be had by mud and stone." This is the *PISE* of France and England. A. A.

FORMAN (JOHN) was the master mason who, in 1526, had under him thirteen masons, two apprentices, one intailer, and seventeen labourers, employed in the erection of the church of S. Michael le Belfrey, York, belonging to the Dean and Chapter, begun 1525, finished 1537. During that period he was likewise the master mason of York cathedral, which building had been just completed: BROWNE, *History of York Cathedral*, 4to., York, 1838-47, p. 270-1.

FORMATION. A term used in geology to express the great divisions of the solid crust of the earth according to their conditions of deposit and to their relative chronological order. Thus rocks are sometimes spoken of as belonging to the plutonic, volcanic, or stratified formations; the primary, secondary, tertiary, and quaternary formations are commonly referred to in works on geology; as are also the carboniferous, the slate, the mountain limestone, the liassic, the oolitic, the wealden, the chalk or cretaceous, and the gravel and drift above the tertiary clay formations. G. R. B.

FORMATION LEVEL. A term used by civil engineers to express the upper surface of the earthwork for a road, for a railway, or for the bottom of a canal, intended, as the case may be, to receive the metal, ballast, or puddle of the finished work. G. R. B.

FORMELLA, FODMELL, or FOTMEL. A weight, now obsolete, mentioned in the statute of weights and measures, of uncertain period, but sometimes called 51 Henry III, 1266-7. FOTHER.

30 formels = a load of lead = 175 stones = 2100 lbs.
1 formel = 6 stone less 2 lbs. = 70 lbs. avoird.
1 load = 12 weys by troy weight = 168 stones.

FORMENT (DAMIAN), see MORLANES (I. and D.)

FORMENTONE (TOMMASO) of Vicenza, according to ZAMBONI, *Memorie*, fol., Brescia, 1778, p. 44, designed 1489 the palazzo municipale or della loggia at BRESCIA, commenced 1492.

FORMER or FURMER, see FIRMER.

FORMERET. A French word adopted in English at the recommendation of WILLIS, *Arch. Nomen.*, 4to., Cambridge, 1844, from DE L'ORME, *Architecture*, fol., Paris, 1691, for the rib placed at the junction of a vault with the wall of a building, and which is consequently about half the size of the master ribs. GARBETT, *Principles*, 12mo., London, 1850, p. 180 and 184, seems to include the master rib under this term, which he explains as meaning the rib forming or enclosing each main compartment of the vault.

FORMICA, see ANT.

FORMIGINE, see MARCHESE (ANDREA and JACOPO.)

FORMPEYS. This word, which occurs in the passage "Pro factura ij formpeys chaumeres retournes corbels transowns j sol skownsiom pro ij fenestris in grosso lxvj s. viij d." under the date 1450 in the SURTEES SOCIETY, *Hist. Dunelm. Scrip. Tres.*, cccxxv, 8vo., Newcastle, 1839, has not yet received a satisfactory explanation unless "the stones that constitute tracery" be adopted, as suggested by WILLIS, *Arch. Nomen.*, 4to., Cambridge, 1844.

FORMULA. The diminutive of FORMA, in the sense of tracery, according to WILLIS, *Arch. Nomen.*, 4to., Cambridge, 1844.

FORNARI (. . . duca di). Near the hôtel de Tingri, afterwards de Matignon, in the rue de Varennes, was that of the marquis d'Estampes, "d'une apparence agréable dont l'étendue de vue est très avantageuse. Cet hôtel ainsi que celui de M. de Vendôme sont du dessein du Duc de Fornary originaire de Sicile, qui avoit la réputation de s'entendre en bâtimens, à cause de quelques desseins qu'il a donnez." The hôtel de Vendôme, afterwards de Rohan-Chabot, in the same street, was erected 1704. BRICE, *Nouvelle Desc.*, 12mo., Paris, 1725, iv, 28-9.

FORNIX. A species of arched construction, by some supposed to be a groined, and by others a barrel vault. PHILANDER, *Vitruvius*, vii, 3, inclines to the latter opinion, and says the groin is properly called *testudo*. CICERO, *Topica*, iv, speaking of various legal obligations, says every one has a right to join a cross wall to a party wall (*parietem directum ad parietem communem*) either solid or arched (*fornicatum*), and then shows that the party wall should not be so weakened or injured as to let down the arch (*ut suspendi non possit*), from which some would consider that a common arch was meant. It seems, however, that the law and description would equally apply to the vaulted or groined lower story, so frequently found both in ancient and modern Rome. On the other side, it may be argued that *fornix* is derived from the old Latin word *fornus* an oven, and that the arching this latter is much more like that of a groin than a barrel vault. Again, that CICERO, *De Oratore*, iii, speaks of the vault of heaven as *celi ingentes fornices*; that while the triumphal arches of Severus, Titus, and Constantine, are always called *arcus*, that of Fabius is generally called *Fornix Fabianus*, CICERO, *Verr.*, i, 19; and that it was probably groined as the arches of Janus are, the before mentioned structures being barrel vaults. In the curious and valuable epistle of SENECA, 90, where different inventions are described, he says that Democritus is generally considered to have been the inventor of the *fornix*, "so that the curve of

stones gradually inclined might be bound together by the key-stone", *medio saxo*. But this author goes on to say, this cannot be, as there were bridges and gates before the time of Democritus. From the use of the expression bridge, it seems clear that SENECA understood *fornix* to mean an ordinary arch. Democritus, however, might have been the inventor of the groin which is tied together by the '*medio saxo*' just as the arch may be said to be. It is to be expected there will be confusion when technical terms are used by non-professional men; and to go further, it happens sometimes that the language of the country itself is not copious enough, and does not contain sufficient terms to explain all the conditions that exist. Thus in English the term *vaulted* means both *arched* and *groined*. By *arched*, a simple barrel vault is meant. But there are two distinct sorts of groins, although there is but one phrase to describe both. The first is the intersection or piercing of one barrel vault by another; here the line of intersections or groin points are *external* angles, or *arises*. The second is when the four sides of a room each incline in a curve towards the centre, and meet either in a point, or a ridge line, as the chamber is square or oblong; the groin points here of course are *internal* angles. Now the Latin language has four phrases for arched work: 1, *cameratio* (*CAMERATED*), which is so vaguely used that it may mean vaulting of any kind; 2, *ARCUS*; 3, *FORNIX*; and 4, *TESTUDO*. The second phrase clearly means a simple arch; and the probability is the other two mean the two sorts of groining above mentioned: and if we reason from analogy, and observe the shape of the turtle shell, the probability is that by *fornix* the first description of groin is meant, and by *testudo* the latter. LIVY, in two instances, xxxvi, 23, xlv, 11, uses the word to signify sally ports, but as these usually issued from the flanking towers of a curtain wall, it is very probable they were groined over. Like the 'dark vaults' in the Adelphi, and the 'dry arches' of Waterloo bridge, the *fornices* of Rome acquired a very disreputable celebrity, as noticed by HORACE, *Satir.*, i, 2, 30; JUVENAL, iii, 156, xi, 171.

A. A.

FORNOVO (GIOVANNI BATTISTA) designed the church dell' Anunziata at Parma, commenced 1566. NOUV. BIOG. GEN.

FORT and FORTALICE, see FORTRESS.

FORTIFICATION. The science of protecting any place against a besieging enemy by walls, ditches, towers, and other constructions. This is the most important branch of military engineering, and has but little to do with architecture. Several professors of the latter art have, however, been employed on the former. Thus Michael Angelo fortified San Miniato near Florence; San Gallo, the quarter of Santo Spirito at Rome; and Vignola erected the fine building at Caprarola which is partly a fortress and partly a palace. In mediæval times Gundulph is said to have built the castle at Rochester, as well as that generally called "the Tower" of London: and William of Wykeham those at Queenboro' and at Windsor. It has, however, been much doubted how far the mediæval ecclesiastics were concerned in the actual design and execution of the various buildings which bear their names, further than providing the funds for carrying out the same. In modern times the architect has scarcely anything to do with fortification, unless perhaps to design the chief entrance to a tower or fortress, or rather the decoration of such constructions. In these cases no settled rule can be laid down, except that in solidity and boldness of effect they should harmonize with the works around and the purposes for which they are intended: the works by San Michele at Verona, etc., are celebrated examples in this respect.

A. A.

The attention shewn in civil, including ecclesiastical, architecture to the necessary measures of defence in the Middle Ages has been overlooked as well as overrated. While the superimposed stories, the enclosed courts, and the slits cut for light to the lowest story of a building are forgotten to be the long-abiding results of an attention once necessary to security,

other features, originally defensive in their intention, are taken as proofs that the buildings which exhibit them were meant to repel an armed attack. Thus French writers seem to recognize that character in English churches which have embattled parapets; and, as will presently appear, some English authors have not exceeded them in accuracy. The defensive architecture of England and France has been well illustrated by TURNER and PARKER, *Some Account*, 8vo., Oxford, 1851-9, and by VIOLET LE DUC, *Diet.*, that materials may be easily obtained from which to judge of the amount of military character that was abandoned from age to age in the dwellings of our ancestors. But the fortification of churches is so exceptional, that mention of details may be excused in the following notice.

There is perhaps no instance of the absolute fortification of a church in England, so far as that implies the preparation of means for actively, and not merely passively, resisting assault. PARKER says, ii, 168, "there are a few instances in England of church-towers having been fortified, and these are not confined to the Border countries; in some cases a regular licence was obtained from the crown to fortify the church-tower, as we have before had occasion to mention." He evidently refers to p. 22, where, alleging that "it would not be easy to point out an example earlier than the close of this century" (meaning in England in the fourteenth century), "of its being necessary to obtain leave to fortify the belfry of a church; yet a license for that purpose was obtained by the priest of Harpham," in the East Riding of Yorkshire, in 1374, as cited from the Patent Rolls, p. 1, 48 Edw. III, m. 31, "de campanili in cimiterio kapelle de Harpham Kernellando." But he continues, "there is only one similar example within the writer's knowledge. Henry the Third granted to the monks of Holmeultram in Cumberland, that they might keep bows and arrows, and use them against the marauding Scots of the Western Borders." Although only citing the license for crenellating one tower, he abstains from speaking of a fortified church, though it must be noticed that at p. 199 he says, "it ought not to be forgotten that nearly all the old churches in Northumberland have low square battlemented towers, and that many of them give proof of having been inhabited." The student must decide for himself whether WALCOTT, *Church, etc., Arrangement*, in Roy. Inst. Brit. Archts. *Trans.*, 1860-1, p. 66, saying that while Hulme exhibits all the features of a fortified position, others on the coast, as at Furness, had watch-towers; and that Holy Cross, Bective, and Crossraguel were fortified; means that the churches themselves were forts, or that their precincts were converted into fortresses: the statement, by the same author, that "at Cashel a castle forms the west end of the cathedral" will startle those who regard the pile as merely a massive western tower, forming a rather late addition to the church. Those who doubt that English churches were either fortified or used as places of security, or were used other than as sanctuaries, may doubt the intention of the so-called room in the roof of the church at Killaloe, which is only approached through an opening in the front gable; of the loft in that at S. Kevins, and at Columbkille, which are entered through a hole in the ceiling of the church; and of the chamber over king Cormac's chapel at CASHEL, to which there were certainly stairs: WILKINSON, *Practical Geology*, 8vo., London, 1845, p. 93-6, insists that these lofts were intended for security, and p. 106, that such was the use of similar chambers over the chancels of the abbeys at Jerpoint, Boyle, and Ballintubber.

It is of course not intended to deny that the monastic and episcopal premises were enclosed by a protecting wall as soon as possible, with license or, perhaps, without it; when the episcopal palace at Wells was fortified 1340, it was surrounded with a moat, and an embattled wall flanked by semicircular towers, *BUILDER Journal*, xix, 625; but even the license, 1174, for closing the precinct, "inforciaretur," at Bourges, does not convey the idea of fortification to ROMÉLOT, *Deser.*, 8vo., Bourges, 1824, p. 118. On this subject reference should be

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made to the licenses to crenellate, 1256-1483, given in the *GENTLEMAN'S MAGAZINE*, 1856, 3rd ser., i, p. 208, 323, 467; and in PARKER, iii, as above mentioned. In Ireland frequent instances still exist of such fortifications; as at Kells founded about 1190, where the place was surrounded by a line of seven or eight towers connected together by a strong wall to protect the inmates from the ravages of the native Irish.

Several abbeys were fortified, many of them being places of considerable strength. Bury St. Edmund's in Suffolk, in 1327, resisted for some time the repeated attacks of 20,000 insurgents; Binham priory in Norfolk was closely but unsuccessfully besieged in the reign of John; S. Benet's, at Hulme in Norfolk was so strongly fortified, appearing more like a castle than a cloister according to old accounts, that William I. attacked it in vain until a monk betrayed the place; so important as a position of strength was it considered, that in 1382 the insurgents contemplated occupying it against any attacking force: Ewenney priory in Glamorganshire is another specimen; TAYLOR, *Index Monast.*, fol., London, 1821. "In a list of Northumbrian fortresses taken during the minority of Henry VI, several fortified parsonages are enumerated amongst the *fortalicis* or lowest order of castles;" SURTEES, *Durham*, fol., Lond., 1816, i, 157.

The existence of fortified churches in France does not admit of question. In that country it would seem that the villages and towns of the earlier portion of the middle ages were left by their military lords unenclosed by walls; and that when the free-towns arose, the inhabitants neglected the Roman practice of first building the rampart, and were generally content with the intention of erecting the wall of their town when they should become sufficiently numerous and wealthy. In both cases, the most ready (fortress as PARKER, ii, 168, calls it, or rather safe, either in a quarrel with a neighbouring lord or with a roving band, was the church, into which the most valuable property was carried, says PARKER, in case of alarm. Some ecclesiastical princes possessed a fortified residence; but, where there was no castle, the church became the fortress of the clergy, and sometimes the refuge of their subjects. VIOLET LE DUC, i, 227, speaking of the south of France, exhausted by the religious wars of the twelfth and thirteenth centuries, and consequently too poor to build churches consisting of more than a nave, says that the remembrance of the civil wars gave the appearance of military works to the ecclesiastical edifices, and adds, in words so vigorous that translation would be hurtful, that "beaucoup d'entre eux étaient réellement fortifiés. L'église abbatiale de Moissac avait été fortifiée au moment des guerres des Albigeois; les cathédrales d'Alby, de Béziers, de Narbonne, et presque toutes les églises paroissiales ou monastiques élevées pendant les xiii^e et xiv^e siècles étaient défendues comme de véritables forteresses, adoptaient par conséquent des formes simples, ne prenaient que des jours étroits et rares à l'extérieur, se couronnaient de tours crénelées de mâchicoulis, s'entouraient d'enceintes, se construisaient sur des points déjà défendus par la nature, n'ouvraient que des portes latérales, détournées souvent, difficiles d'accès, protégées par des défenses. Après les guerres civiles étaient survenues les guerres avec l'Aragon, toutes les villes du Languedoc faisant partie du domaine royal sous S. Louis, Philippe le Hardi, Philippe le Bel et Charles V, frontières du Roussillon et du comté de Foix, étaient continuellement en butte aux incursions de leurs puissants voisins. Chaque édifice avait été utilisé dans ces villes, pour la défense, et naturellement les églises, comme les plus élevées et les plus importants, devenaient des forts, participaient autant de l'architecture militaire que de l'architecture religieuse." PARKER, ii, 168, mentions the cathedral at Dol as strongly fortified, and notices the very remarkable instance at Etampes, where the church has guard rooms with loopholes over the chapels, while the chapels themselves have windows so high from the ground that the congregation could not easily be molested. This appears very similar to the arrangement of the church at Beaumont, described p. 336 of

the same volume. GUENEBault, *Dict.*, s. v. *église*, appearing to apply the term fortified to any church having BATTLEMENTS, says that the fortification of churches was specially frequent in the tenth and thirteenth centuries in England, France, and Germany; but he only cites the abbey of S. Germain-des-Prés, S. Victor-de-Luze, Tournus, and the church (of the eleventh or twelfth century) at Royat. The latter is given in NODIER, *Voy. Pitt.*, fol., Paris, 1829 (Auvergne), i, pl. 74; and by GAILHABAUD, *Monumens*, 4to., Paris, 1850, No. 81 (who also mentions that at Redon in Bretagne), and an elevation of the front restored is shown by BATISSIER, *Histoire*, 8vo., Paris, 1845, p. 550-1, who says that the machicolations were additions; he notices the north wall of the church at Montelaux-Moines in the Bourbonnais, the churches at Esnaude (Charente Inférieure), Les Saintes Maries in La Camarque, and Sinorre (Gers), as having embattled parapets over machicolations. After observing that some churches were moated and looped, and that others, like the small Romanesque basilica of Notre Dame-du-Fort at Etampes, were defended in front by an embattled wall; this author explains that many of these fortifications were additions to the original work in the north and west of France, especially during the English war in the fourteenth and fifteenth centuries; and that the churches in the south had been fortified from the time of the Saracen invasions until the article of the Council of Avignon, 1209, which regulated this subject, as appears in D'ACHERY, *Spicilegium*, 4to., Paris, 1657, p. 613. Besides these, notice should be taken of the church at Redon, shown in NODIER (Bretagne, ii); the fortified Romanesque abbey (in ruins, but retaining its ramparts, gates, and donjon) at Cruas, which stood sieges in 1584 and 1585; the church at Dorat, of the tenth century, which has turreted walls in the form of a fortress; and the machicolated church at Maguelonne, 1048-1200, which is supposed to have been so constructed, like that of Almeria on the coast of Granada, to resist a coup-de-main from corsairs; RAMÉE, *Hist.*, 12mo., Paris, 1843, ii, 146, 177.

The term "fortified church" seems to be applied by WEBB, *Sketches*, 8vo., London, 1848, p. 75 and 82, in Germany, to those at Muenster-Maifeld and Oberwesel; of the former he says that the vast western tower is "oblong in plan, with semi-circular turrets on the shorter sides, the whole is embattled as if for defence, and the top overhangs in a most unchurchlike way;" of the latter he notices that the tower is "extremely massy, square, with heavy buttresses and angular turrets, and was clearly meant for defence, as it is provided with machicolations, and the embattled parapet is pierced with arrow slits;" he also mentions that the churchyard at Remagen is fortified. Instances of this practice in Rhenish Prussia may be countenanced by examples in Transylvania, as at Muchlenbach and at Tartlau with one rampart, Szászvaros with a moat and bastioned double walls, and at Mediasch with a strongly bastioned triple line of defences, according to TSCHISCHKA, *Kunst*, 8vo., Vienna, 1836, p. 309.

FORTRESS. The technical name for any large place strengthened by artificial means; CASTRA, CASTRUM; or indeed for any place which naturally possesses features available for the defence of its inhabitants. A fortified town is a fortress, but that title is frequently given to a castle, especially if it be of large size, as the Tower of London. The word fort applies to a fortification of small size, such as a citadel, or even to lesser works, such as a castle; STATIO. Less than this was the tower or CASTELLUM, and the burgh or DUN: to this class belong the *raths*, moats, mounds, and circular forts described by WILKINSON, *Practical Geology*, 8vo., London, 1845, p. 55-60. Fortalice is explained as the lowest order of castlet by SURTEES, *Durham*, fol., London, 1816, i, 157 (*Scottish*, peel), which is the *turris* of HORSLEY, *Brit. Rom.*, fol., London, 1732, p. 108, although, from the vagueness of mediæval documents, *fortalitium* may sometimes mean a DONJON or keep, as mentioned s. v. CASTLE, where also notice will be found of the

use of the words *dominium*, *firmitas*, *mota*, and *munitio* for forts. With regard to the vitrified forts of Scotland, reference may be made to FORSYTH, *Beauties*, 8vo., Edinburgh, 1805-8; ii, 391-7; iv, 530; v, 307, 318; and the SOCIETY OF ANTIQUARIES, *Archæologia*, 4to., London, 1792, x, 147. CLAY-WALLING; EARTH-BUILDING.

FORTROSE. A royal borough and seaport on the shore of the Moray Firth, in the county of Ross in Scotland. It comprises two places, Chanonry, so called from being the canonry of Ross, where the bishop had his residence, and Rosemarkie, with which the other was united, 1444, under the common name of Fortross, now softened into Fortrose. Only a small part of the ancient cathedral now remains, it having been destroyed by Oliver Cromwell, who took the stones to add to the citadel at Inverness. What exists seems to have been an aisle or chapel having an arched roof, about 100 ft. in length and 30 ft. in breadth, communicating by means of entries or porches with the main body of the cathedral. The style is of the purest elaborate Middle Pointed architecture; the building was preserved and repaired by some of the bishops since the Restoration as a place for public worship; while in 1854 it was under extensive repair by the Commissioners of Woods and Forests, for eight months, rendered necessary from its ruinous state. There are some defaced effigies in the walls; and an old bell hung in a modern spire. In the direction of the main body, at the east, and detached from its remains, stands what was probably the chapter house containing a vault below with a strong arched roof, with sedilia round it for the canons; in later times it was converted into a prison, and is still used as a coal cellar; the upper part, lately repaired, is the council chamber of the borough. There is an Established church, a Free church, and an Episcopalian church. A number of old quaint looking dwellings appear from their title deeds to have been the manses or residences of the canons of the cathedral. J. M.

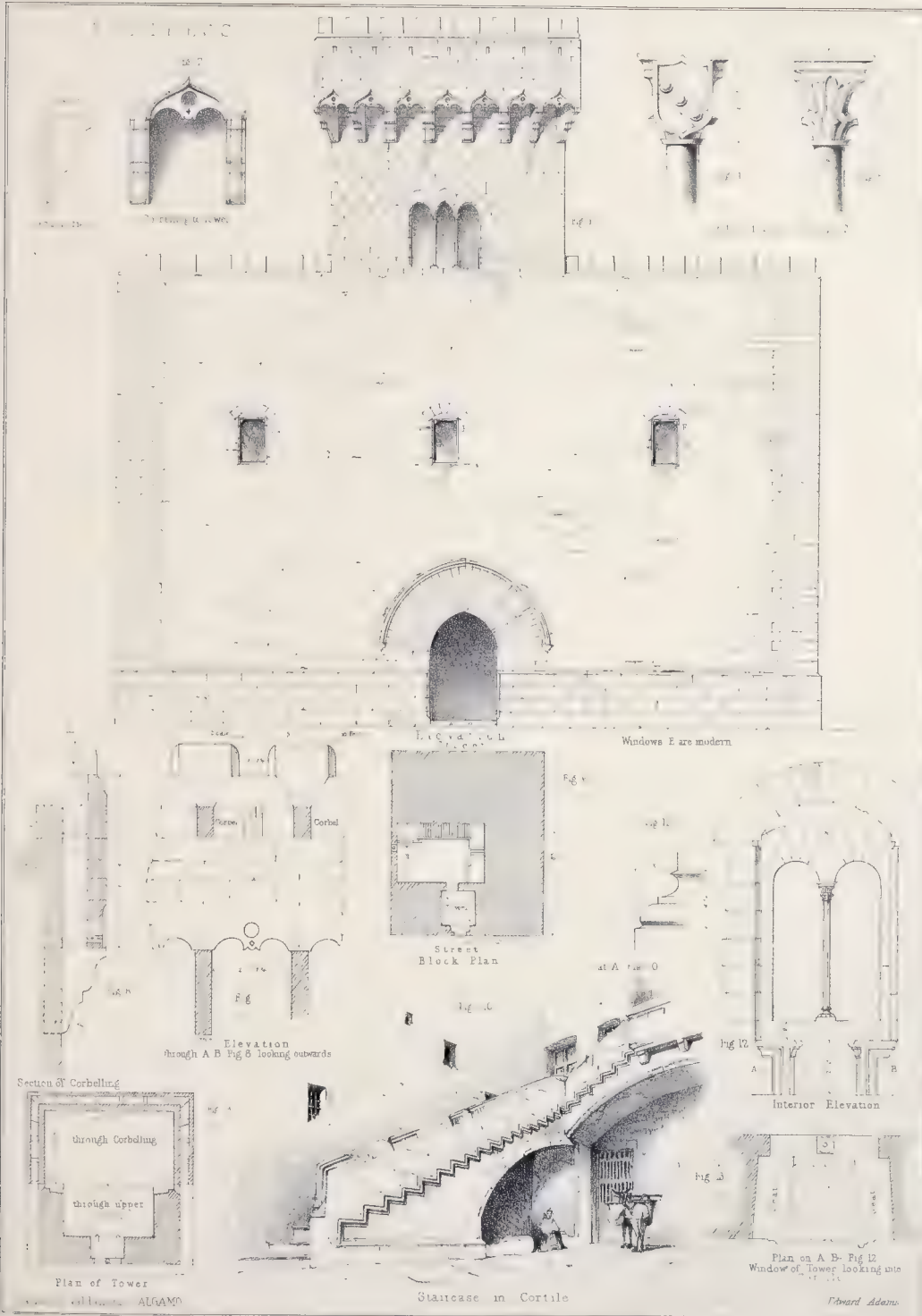
FORTUNÆ FANUM, see FANO.

FORTUNAT STONE (SAINT), see LYON.

FORTUNE (TEMPLE TO). A name attributed to the remains of several temples, but which is only applicable with any degree of certainty to two. One of these is at present called the church of Sta. Maria Egiziaca, near the north end of the ponte rotto at Rome, which is supposed to exhibit the remains of a temple to Fortuna Virilis: the front consists of four columns 28 ft. high, of the Ionic order (the intercolumns have been walled up), forming a stoa, flanked by seven others, four of them being engaged in the wall of the cella. This work, which is considered the purest specimen of the Order at Rome, stands on a basement of travertine, and is itself composed of travertine and tufa, the columns and entablature being covered with stucco. It is to this fact that BRAUN, *Museums*, 12mo., Brunswick, 1854, p. 29, alludes, when he states that it is worth while to notice the "stucco or terra cotta" work of the frieze representing heads of oxen, candelabra, and wreaths of flowers borne by children. The statements upon which the remains have received this title are considered by BURGESS, *Topography*, ii, 137.

The other is the temple to Fortune at Præneste; of which the present ruins appear to belong to imperial times, and consist of four half-columns of the Corinthian order in the piazza Tonda, near the cathedral, and three others in the wall of the chapel of the cemetery: the semicircular and vaulted corridor below is supposed to be covered by the palazzo Barberini.

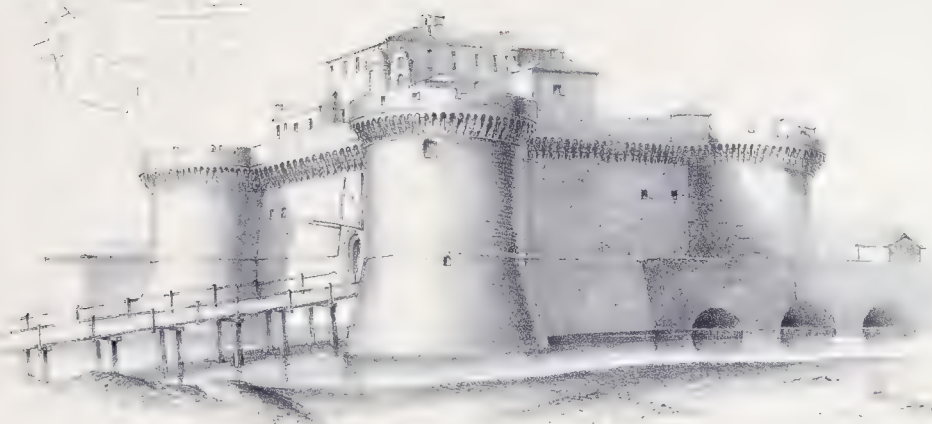
The eight granite columns with white marble capitals of an Ionic order, in the Forum to the south-west of the Arch of Titus at Rome, were supposed by Poggio BRACCIOLINI, 1431, to belong to the temple to Concord, but this title was afterwards changed to that of Fortune, by which name the columns were known until the theory prevailed for a short time that they belonged to the temple to Vespasian; more recently the probability that they mark the site of a temple to Saturn has been



Lithographed for the Society by F Bedford, December 15th 1863



FORTRESS



Leons Val ramp



TIVOLI.

admitted, for reasons given in a paper by BURGESS, *On the Topography of the Roman Forum*, read at the Royal Institute of British Architects 28 June 1852, controverting an opinion expressed by him in *Topography*, 8vo., London, 1831, i, 411.

FORUM (Gr. ἀγορά, meaning any assembly of people; the place of such assembly; and a market). A Latin word which, as may be gathered from a comparison of VARRO, *De L. L.*, v, 145, with S. Pompeius Festus, s. v., is derived from the word 'foras,' out of doors. The latter writer says the word 'forum' had four significations: 1. A place of business, as the Flaminian and the Julian forums; 2. One in which judicature was carried on; 3. Another of the same nature, but dedicated to provincial business; and 4. The vestibule or entrance to a sepulchre; while the masculine form had two other meanings. In the infancy of every city the usual place of resort was the marketplace where goods were brought for sale, and where public meetings for elections, etc., were held: and like the marketplaces of England and elsewhere, it had a market house where the assizes or sessions were held for the administration of justice; hence the constant occurrence of forum in the ancient names of places, as Forum Livii, Forum Sempromii, etc. As towns grew into cities by degrees, the butchers' shops, as at Rome, gave way to those of the argentarii or bankers; and at last, one class of forum became a great assemblage of public buildings, dedicated to the purposes of religion, legislation, and jurisprudence, as those of Julius, Augustus, Nerva, and Trajan at Rome; while the other class still continued to be markets: thus the forum boarium was the market for cattle in that city; the olitorium for vegetables; the piscarium for fish; the coquina for ready cooked provisions; the forum cupedinis the market for dainties; and thus arose the distinction between the fora civilia or judiciaria and the fora venalia at Rome. VITRUVIUS has devoted the beginning of his fifth book to the subject. He states that the forum of the Greeks was square, with very large double porticoes (colonnades or cloisters) formed of columns near each other, to give as much shelter as possible, and an ambulatory or gallery for walking on the top of them: but that the Italian forum differed from that of the Greeks, inasmuch as until the erection of amphitheatres, the exhibitions of gladiators were held there; that the intercolumniation was wider; that there were the shops of the bankers under the porticoes (it would seem that the management of the public revenue was usually accommodated in the gallery above); and that there were balconies (moeniana) on the upper floors (superioribus coactionibus) for spectators, the letting of which formed a source of public revenue. The Italian forum, he states, was in width two-thirds of its length, and usually contained a basilica, or court of justice, with its chalcidicum, the treasury, prison, and curia, or senate house. From this author it may also be gathered that the theatre and baths were placed there or in the vicinity, if it were a healthy locality. A curious description is given in PAUSANIAS, vi, 24, of the agora at Elis, which, from his account, does not appear to have been square, but which he says was of antique form and arrangement; the modern agora, probably the same in design as that described by VITRUVIUS, being as he says of Ionian origin. By some writers this description has been supposed to be a type of the Greek agora, but the contrary may be deduced from his enumeration of its peculiarities, one of the most striking of which is that one of the temples had no walls, and the roof was supported on trunks of oaks hewn with the axe. From the various accounts, however, it may be gathered that the Greek agora differed very little from those of Italy (the Prytaneum, or residence of those in office, was an institution unknown to Rome); the square plan, and the difference in the colonnades, and arrangements above them before described, being in fact the only points in which they varied. There are no important remains of these objects except in Rome, and in Pompeii. The remains of the forums in the latter city are in such condition that there is no doubt about the use of their various monuments, and the larger one

supplies details which are interesting. All writers seem to agree that its area was open to vehicles, although it was not paved in the same manner as the streets, but was covered with large regular slabs of marble. These were joined together and laid with great accuracy, as evidenced by the small portion which still exists. Remains of iron gates were found at several of the entrances, from which it may be inferred that the forum was only open during fixed hours, like the Royal Exchange. The height of the columns was 12 feet, with an intercolumniation of about 6 ft. 10 ins. towards the area, and they formed a cloister about 15 ft. wide in the narrowest portion. The only accessory to this forum which seems to deserve special notice is the recess in which stood the public measures, five of them with sliding bottoms for grain, and four with tubes for oil and wine. The position and component parts of the principal forum at Rome have given rise to a long and keen controversy: the authors who have written on this subject, including the views derived from the latest discoveries, are considered by ASHPITEL, in two papers read before the Royal Institute of British Architects, *Transactions*, 1856-7, p. 105, and 125, which also mention the later writings and theories of CANINA, with plans of the four chief theories as to its boundaries.

The *meidan* is the agora or forum of Asiatic cities, as at Constantinople and Ispahan.

A. A.

FORUM JULII. The ancient name of FRÉJUS in France.

FORUS. The Latin name given to each range of seats in the Roman circus, according to the usual but doubtful translation of LIVY, i, 35 and 56, and Festus, s. v.; the word is also used for *forum* in LIVY, xxix, 37, and xlv, 1.

FOSCHINI (ANTONIO), son of Gaetano Foschini of Ferrara, was born 14 June 1741 in Corfu. He became 'ingegner comunale', and professor of architecture in the university of Ferrara, in which city he designed 1793 the oratorio Ferretti; and 1795 the theatre, one of the largest and finest in Italy. This was not completed 1798, when he was ordered by the French authorities to put on the roof before the walls had attained their intended height. Besides the staircase at the palazzo del Paradiso, converted 1567 into the university in that city, he designed the church of the Corpus Domini; the large hospital at Comacchio; the theatre at Lendinara; and a basilica at Bondeno. The latter work was on the eve of completion when he died 14 December 1813. CICOGNARA, *Orazione in Morte*, Ferrara, 1814; NOUVELLE BIOG. GÉNÉRALE. 83. 84.

FOSSANO. A city in the province of Cuneo in Piedmont. The town, which is seated on a hill surrounded by ramparts and crowned by a castle, has wide and straight streets that are chiefly lined with very low arcades. The cathedral, under the invocation of the Assumption and S. Giovenale, was designed by Guarini some time after the establishment 1592 of the bishopric. Several parish churches, a monastery and a nunnery, the episcopal palace at some distance from the cathedral, the collegio de' Somasche, the congregazione dell' oratorio, the reale collegio, the ospedale, and outside the walls the church of S. Sebastiano by G. Boetti, are the chief public buildings. 28. 96.

FOSSANO or DA FOSSANO (AMBROGIO) designed the richly decorated façade, commenced 1473, of the certosa della Beata Virgine delle Grazie near Pavia, according to MALASPINA, *Guida*, 8vo., Pavia, 1819, p. 113, 116. It is generally supposed that he was the celebrated painter also called 'il Borgognone', but as the latter is not known as an artist before 1482, and as his latest work is considered to be dated 1535, there seems reason to believe that there may have been two artists called Ambrogio Fossano. 28. 62. 68.

FOSSATO (FELICE) is said to have commenced about 1552, the loggie nearly 400 ft. in length, which include the custom house and the theatre, in the piazza Maggiore at Arezzo; but these loggie are ascribed to Vasari 1573 by RONDINELLI, *Relazione*, 8vo., Arezzo, 1755, p. 96.

FOSSA'TOR, see FOSSOR.

FOSSE D'AISSANCE. The French term for a cesspool. It is noticed, because the French police regulations with respect to the inevitable evil referred to are worthy of consideration in situations where no sewerage exists.

According to the "Ordonnance de Police" of 23 Oct. 1850, no new fosse d'aisance can be formed, or old one repaired, without the permission of the police, and every demand for such permission must be accompanied by a plan and description. No fosse d'aisance can be emptied unless by the regular contractors; nor can it be filled in or converted to any other use without due notice to the authorities: numerous precautions are prescribed for the safety of the workmen employed in works of this description. The materials employed must be of the densest and most non-absorbent description (in Paris, the *meulière* alone is tolerated), and carefully bedded in the best hydraulic mortar, to ensure their being left perfectly water tight. No construction of this description is allowed to be used until it has been examined by the surveyors of the police. The usual dimensions of the fosses d'aisance of Paris are 10 ft. in length, 5 ft. 8 ins. in width, by 5 ft. in height to the springing of the semicircular vault; a manhole is formed 3 ft. 4 ins. by 1 ft. 2 ins. by 1 ft., the thickness at the key. When they require to be emptied, notice must be given to the *agents de la salubrité publique*, who attend and direct the operations; in the winter between 10 P.M. and 7 A.M.; in summer between 11 P.M. and 6 A.M.: the night carts are also under the superintendence of the police, who require them to be air and water tight. Of late years the 'fosses mobiles' have been much used in Paris. They consist of air-tight vessels, easily connected with or detached from the soil pipe, which are removed bodily to the *vidanges* when full. Both descriptions of fosses are, however, objectionable, because they interfere with the adoption of water-closets; but, on the other hand, they have the advantage of preserving the manure in its most valuable form. The requirement of absolute water tightness in these constructions is the one most worthy of imitation. Dead wells are too often used in England in place of well constructed cesspools. G. R. B.

FOSSIL FLOUR, see **FLOATING BRICK**.

FOSSITIA ARENA. A term used for pit sand, in opposition to **FLUVIATICA** for river sand, by **VITRUVIUS**, i, 2, and ii, 4, where he mentions the four sorts into which he distinguishes it.

FOSSOMBRONE. A city in the legation of Urbino. The remains of the Latin city called Forum Sempronii are about twelve furlongs to the east of the town in the piano di S. Martino; **CALINDRI**, *Saggio Storico*, speaks of the ruins of a theatre and of a gate: the vestiges of a temple to Bacchus are said to exist to the west of the town in the piano del Cerreto, so called under a belief that the celebrated temple to Ceres stood there. The original modern city occupied the hill that is now the north-west portion of the present town, which has been steadily extending down the hill and into the plain since 1519, when the walls were destroyed. Of the two bridges over the river Metauro, that of S. Antonio, built 1767-1800 by Melchiorri in one arch, is regarded in Italy as a *chef-d'œuvre*. The three-ailed cathedral, dedicated to S. Maurenzio, was rebuilt 1772 from a design by Morelli, and consecrated 1784. The five parish churches with S. Giovanni Battista, S. Aquilino (chiesa nuova) commenced 1608 and consecrated 1726, S. Agostino (formerly Sta. Maria) modernized 1735, and Sta. Francesca Romana degli Angelini rebuilt 1753; the monastery of the Capucins 1529, and that of the Minorites modernized 1626; two nunneries; the ospedale; the orphan school 1579-1609, with its oratorio erected about 1650-90; the founding hospital 1718-55; the seminary, which is in two edifices, one containing the casa Quarantucci and the old church of Sta. Anna united 1770, the other being the palazzo Passionei, acquired 1824; the episcopal palace, formerly a Benedictine monastery, altered 1379-1408, almost reconstructed 1470 (with a diamond-faceted front dating 1497), enlarged 1579-1609 and 1718-55,

and modernized 1804 and 1824; the monte di pietà 1492-1507, with a front faceted in like manner; the palazzo comunale, rebuilt 1564 with a frontal so faceted (the campanile was erected 1765); and a modern theatre, are the principal buildings. 96.

FOSSOR. The fossor or excavator in the catacombs at Rome is represented in **BOTTARI**, *Roma Subterranea*, fol., Rome, 1737-54, in several engravings from paintings formerly existing on the walls of those passages. In late Latin (1365-6) 'fossator' was the term for a person who was employed in digging; as appears from **BRITTON** and **BRAYLEY**, *Hist. of the Palace at Westminster*, 8vo., London, 1836, p. 197.

FOSTER (JOHN), of Liverpool, held the offices of architect and surveyor to the corporation, and engineer to the docks; practising at the same time as a builder. To him is attributed the coffee room and library called the Athenæum (Italian) completed 1799 at a cost of about £4,500, given in **RICHARDSON**, *Vitruvius Britannicus*, fol., London, 1808, ii, pl. 43-4; and the Exchange Buildings (Grecian) 1803-8, at a cost of £110,848; James Wyatt is presumed to have been consulted upon it. The other important works constructed by him are considered to have been designed by his son. He died in 1824.

FOSTER (JOHN), F.R.S., second son of the above, born about 1786, was a pupil of James Wyatt, and is said to have been employed by Jeffrey Wyatt. In 1809 he went abroad, and was concerned with C. R. Cockerell, R.A., in the excavations at Ægina and Phigaleia. Returning in 1816, he entered into partnership in the building firm with his brother, from which he retired on the death of his father, being then appointed his successor as architect and surveyor to the corporation, with a salary of £1,000 per annum; this office he held until June 1835, when he retired on a pension of £500 per annum. Amongst the works in which his father and himself were concerned, were the church of S. Michael, Pitt-street, 1816, but not completed until 1826 (Corinthian), costing about £45,000, the portico is 61 ft. 7 ins. wide; that of S. Mary for the School of the Blind, originally in Hotham-street, 1818-9 (Doric after the temple at Ægina), but removed 1850, and re-erected in Hardman-street; the S. John's markets, 1820-3, about 183 yards long by 45 yards deep, covering an area of nearly two acres, which cost about £37,000, the roof is supported by iron pillars; the peculiarities of the building stimulated the erection of this class of structure throughout England: the Royal Infirmary, Brownlow-street (Ionic) 1824, at a cost of £27,800; S. George's church, rebuilt 1825; the Custom House or Revenue Buildings (Ionic) 12 Aug. 1828, occupied 1839, erected at an estimated cost of £200,000; the chapel and residence in S. James's cemetery, 1829 (Doric); the public baths, on St. George's pier, 1830, at a cost of £30,000; the Moorish archway connecting the engine houses on opposite sides of the line of the Liverpool and Manchester railway, 1831; and the screen wall of the London and North-Western Railway Company, Lime-street, 1835. After the great improvements in Liverpool in the years 1825-7, the designs for the street architecture of Lord-street and S. George's-crescent were prepared by Mr. Foster. Among his private works are, large additions to New Hall near Warrington, for Sir Robert Gerard (Grecian); the rebuilding in the Baronial style of the ancient portion of Knowsley, Lancashire, for the Earl of Derby, about 1830; etc. He died 21 August 1846. **ENGLISH CYCLOPEDIA**; **PENNY CYCLOPEDIA**, 2nd Supp., 1859; **BUILDING NEWS Journal**, 1857, iii, 398; **TWYCCROSS**, *Mansions of England*, 4to., 1847, iii, 2, 24.

FOTHER or FODDER. A modern weight of lead; **FORMELL** being the old weight; superseded by the ton.

1 fother = 8 pigs. 1 pig = 21½ stone. [*Cyclopædia*, 1788, = 19½ cwt. or 2154 lbs. avoird. London plumbers, **CHAMBERS**, = 20 " at London; and 'Book of Rates'; (**JEAKES**) = 21 " at Newcastle. = 22 " at Stockton. = 22½ " at the Mines. = 2000 lbs. by the 'Book of Rates'; (**HARRIS**)

HARRIS, *Lex. Tech.*, 1710; LANGLEY, *Builder's Assistant*, 1738; ADCOCK, *Pocket Book*, 1829; JEAKES, *Arithmetic*, fol., 1701.

FOTMELL, see FORMELLA.

FOUL AIR. Air rendered prejudicial, and in some cases fatal, to animal life. Atmospheric or pure air is considered by some authors to contain on the average for each thousand parts, nitrogen 788; oxygen 197; vapour of water 16; carbonic acid gas 1; by others the composition is said to be, nitrogen 779.5; oxygen 306.1; vapour of water 14; carbonic acid gas 0.4; and perhaps the latter statement may be the more correct for the atmosphere of England. These elements exist together in a state of simple mixture, not of chemical combination; and therefore even the purest air, if confined in a perfectly still enclosure or vessel, will become foul unless the constituents are maintained in a state of diffusion; they tend, in fact, to separate in consequence of their different specific gravities; thus taking the gravity of atmospheric air at 1000, that of oxygen is 1105.63; nitrogen 971.37; aqueous vapour 623.5; and carbonic acid 1529.01; and it is for this reason that the air at the bottom of wells or of deep shafts consists almost entirely of carbonic acid gas. Atmospheric air may also be rendered unfit for human respiration by the presence of other gases, which occur abundantly in nature; such as hydrogen, carburated hydrogen, miasmata, olefiant gas, sulphuretted hydrogen, sulphurous acid gas; and in modern building, common coal gas. These gases may be furnished by the chemical actions going on in a closed building, whether occasioned by the decomposition of its materials; by the presence of many persons, or of animals; by the decomposition of the elements of the subsoil; or by the methods adopted for heating, lighting, or ventilating the rooms. The decomposition of the materials renders air foul, or unfit for respiration, by the abstraction of oxygen which always takes place during its progress. Animal life tends to render air foul, not only by the consumption of oxygen, but also by the evolution of carbonic acid gas, and the production of nitrogenous vapours in the form of perspiration, or of corporeal emanations. The elements of the subsoil of a building acted upon by damp give rise to the evolution of the sulphuretted hydrogen, or the marsh miasmata gases when it contains organic matters, either vegetable or animal, in considerable proportions. Finally, the methods for heating, lighting, or ventilating, may produce carbonic oxide and carbonic acid gas, as well as in the consumption of oxygen by the materials burnt. The nature and mode of action of the foul air encountered in each particular case which may occur in the course of practice, must determine the precise mode of remedy to be employed by the architect.

GAS (NOXIOUS). VENTILATION. O. R. B.

FOULSTON (JOHN), F.I.B.A., born 1772; studied under Thomas Hardwick; and commenced practice 1796 in S. Alban's-place, Pall Mall. He became first notable as an architect in 1811, when he was the successful competitor, against six others, by an unanimous decision, for a building at Plymouth, comprising the royal hotel, assembly rooms, and theatre, realized at a considerable cost. This structure has a northern front 268 ft. long, with an octastyle portico of columns 3 ft. 6 ins. in diameter and 30 ft. high; the eastern front, of 218 ft., exhibits only one of two intended tetrastyle porticos (Ilyssus Ionic); the ball room is about 80 ft. by 40 ft., decorated with columns (Lysicrates Corinthian); the theatre presents an early application of iron to the roof and skeleton-work of the boxes. His success in this important structure established his local fame; and, taking up his residence in Plymouth, he continued for twenty-five years the leading architect of the neighbourhood. At Plymouth he erected also the athenæum, 1818-9 (Grecian Doric); S. Andrew's chapel, 1823 (Soanean); and public library, interior; the quadrangle of Princess-square (Grecian Doric); and he refitted, with additions and improvements, the interior of S. Andrew's church. His design for the exchange, 1813, was corrupted in its execution; and his front to the public library

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has been since his death necessarily destroyed to make way for the Cottonian museum. In the adjoining township of Stonehouse he built S. Paul's chapel (Gothic): in Devonport, the town hall, 1821-2 (Grecian Doric); civil and military or public library, 1823 (Egyptian); Mount Zion chapel, 1823-4 (Hindoo); commemorative column, 1824 (Grecian Doric), exhibiting the then novelty of raising and setting stones by the derrick; and, in the suburb of Stoke, he erected S. Michael's-terrace, Belmont house, and other villas, all in the Grecian style; supplying also designs for several ranges of street or terrace architecture, more or less carried out. At Tavistock, he restored the old abbey buildings, 1829: at Torquay, designed the public ball room, 1839: at Bodmin, the original part of the Cornwall county lunatic asylum, 1818; and made a design for Bristol gaol, 1816. His influence, however, extended beyond the limits of his employment; and it is in respect to the initiative given by Foulston to art-movement in the south-west of England that he is most deserving of especial mention. He came into a district where there was little worthy the title of classic architecture; the speedy result of his operations was at least a spreading desire for ornamental design; and his name is one which Plymouth has reason highly to honour. Near the close of his practice he united for a short time in partnership with Mr. Wightwick, also practising in the town; and during his subsequent retirement he published *The Public Buildings erected in the West of England, as designed by J. Foulston, & Co.*, London, 1838, in 116 lithographic plates illustrating most of the above works; with his portrait. He died at his residence near Plymouth 13 January 1842, aged 69 years, and was buried in S. Andrew's new cemetery. G. W.

FOUNDATION. The natural or artificial base on which a structure is placed. The subject of natural foundations is treated in this place; artificial ones are noticed in their separate articles.

For the purposes of classification, the various descriptions of strata available for the foundations of a wall may be described as follows:—1st, solid rock: 2nd, incompressible but movable strata, such as sand or gravel, when free from water: 3rd, the same strata when charged with water: 4th, clays or loams in their various states: 5th, compressible strata, such as alluvial muds, peaty lands, or running sands. **CHALK. FOOTINGS.**

1st. Solid rock should be made, as nearly as possible, level throughout. If there should be any great irregularities in the natural surface, compensation may be made for them by the use of concrete, of solid rough masonry, or of brickwork; it being always borne in mind that all these materials are, for a time, liable to compression under an insistent load. A rock may be considered to have sufficient power of resistance when it bears a weight of 100 lbs. per foot superficial without exhibiting any signs of compression. The upper and more weather-worn beds of the limestones, sandstones, shales, schists, and sometimes even of the granitic rocks, are too much fissured to allow of their being trusted as foundations, without the introduction of some mode of distributing the weight over a large area; and they, therefore, require to be treated in the same manner as the strata next to be noticed. But the solid beds of any of those formations may, without hesitation, be used as foundations without any intermediate works.

2nd. Strata, such as gravel or sand, free from water, and sensibly horizontal to a considerable distance from the extreme edge of the building proposed to be erected upon them, are, for all practical purposes, as incompressible as rock itself; but as the small particles of which they are composed are free to move under unevenly distributed weights, it is almost always desirable to introduce between the footings and the gravel a bed of concrete, or some analogous means of effecting the desired object of distributing the weight over a large area. If the gravel and sand, however, should be prevented from spreading laterally, there can be no objection to founding an ordinary building at once upon them; but in such cases it is

essential to inquire beforehand whether there be any probability of a change at any future period in the condition of the strata. CONCRETE.

3rd. When the gravels and sands are charged with water, it is absolutely necessary to resort to some artificial method of forming the foundations. With gravels, there is less danger from any displacement of the materials themselves than with sands of a fine and even character; because the latter act the same as dense fluids, and yield to the pressure of any body of a greater specific gravity than themselves, if there should be any means provided for their escape laterally.

When a building has to be founded upon fine sands charged with water, the first operation to ensure the stability of the work, is to surround the intended site by an enclosure, composed either of whole or of sheet piles, or of iron sheet-piles, in such a manner as to isolate that portion of the stratum from the surrounding sands. This enclosure must be carried down to the solid substratum under the watery sands, so as to prevent the latter from slipping away under the outer edges; and great precautions must be taken to prevent the enclosure from bursting under the action of the load. If these objects can be effected (and there would be no difficulty in so doing unless the sands were of considerable thickness), the whole of the enclosed surface may be rendered fit to receive the building by being covered with a uniform bed of concrete when the weight of the building is not very great; or the portions of the surface immediately under the seats of the walls to be erected may be adapted to receive the latter, by the use of piles supporting a wooden or a stone platform, upon which the lower courses of the masonry are laid.

In the cases of lockgates, foundations for the piers of bridges, or analogous works, it is customary to drive piles all over the surface (an operation which, if carefully performed by driving them, beginning from the exterior and working towards the centre, tends to consolidate the foundations by compressing the ground itself); and at times it may even be desirable to act in the same manner with other buildings, as dock warehouses, etc.; for ordinary civil constructions, however, it will suffice to pile simply under the walls. PILE, and PILING.

4th. Clays and loams in their usual state are, for all practical purposes, incompressible, and a building may be erected upon them without the interposition of concrete or of any artificial foundation, so long as the clays and loams are prevented from spreading or moving laterally, and provided their natural surfaces have been attained. The danger to be apprehended from clay subsoils is in the fact that beds of sand are often intercalated between the principal beds of clay; and if, under such circumstances, the edges of the sands should be laid bare at a lower level, and water should get into them, they would be likely to slip under the action of a heavy weight. Beds of clay, near the surface, sometimes become dry in unusual seasons of drought, and, in buildings constructed without reference to their condition, serious settlements invariably follow. Upon a hill side it becomes necessary to carry the foundations upon a clay or loam to such a depth as to prevent any lateral displacement of the upper beds. At present, it often happens that unnecessary expense is incurred in the execution of concrete foundations on sands, loams, and clays in flat, horizontal plains, where, in fact, all that is absolutely necessary is to carry the walling through any vegetable soil, or made earth, to the undisturbed ground, and to prevent water from penetrating between the bottom of the walling and the seat upon which it rests. Even the Oxford and London blue clays, if occurring in a plain, would be found incompressible under a load of 50 lbs. to the foot superficial; but they have occasionally been known to slip when their surfaces have formed an angle of 1 in 10 to the horizontal line, so that it would be advisable, in the erection of a building of any importance, to consider the line of stability of these strata to be at least 1 in 12, and to carry down the foundations accordingly, even when they are dry.

If the clays and loams should, however, be covered with water flowing over their surfaces, the source of that water should at once be intercepted, by any of the processes adopted for dealing with subterranean water-courses. It is desirable, in all cases of building on wet clay, to surround the footings by close piling, and to intercept the passage of water beneath their surface; and at any rate, to ensure the uniform and equal compression of the subsoil immediately under the footings by isolating it from that surrounding it. If, by reason of any local circumstances, there should flow over the top of a bed of clay or loam a spring, so powerful as not to be susceptible of being diverted, the foundations must be supported upon piles, or cylinders must be employed.

5th. Compressible strata, such as peat, alluvial lands, sands intercalated with peaty beds, and running sands, are the most difficult to be rendered fit to serve as foundations. If it should be possible to form round the position intended to be occupied, a water-tight enclosure or a coffer-dam, it would certainly be advisable to throw out the whole of the materials so enclosed, and to carry the foundations down to the solid substratum. But it frequently happens that the thickness of the class of strata thus described is so great, that the expense of making a coffer-dam could not be incurred; in this case piles or cylinders must be used, according to the importance of the building, especially if the compressible strata under consideration should be liable to move laterally. Instances exist in which the soft alluvial muds are so thick that it is impossible to reach their supporting strata by any of the ordinary processes; thus, in the case of one of the new railway bridges upon the Loire, it was found impossible to reach a solid bottom even by the use of piles, scarfed together so as to form a length of about 120 ft. At L'Orient, again, the semifluid mud is of such an indefinite depth that no piles can reach the bottom; the method adopted in both these cases has been to surround the intended position by a close piled sheeting, and then to stud the enclosed space by numerous piles, in such a manner as to compress the mud itself as far as possible. The descent of the piles is, under these circumstances, simply resisted by the friction upon their sides; and at L'Orient, another element of resistance was obtained by driving the piles with the butt end downwards. All such foundations must, however skilfully executed, be considered to be unsatisfactory, and they must constantly be liable to subsidence and to lateral displacement. The most important precautions to be taken with them are, 1st, to ensure a permanently tight enclosure; 2nd, to ensure a firm, even platform all over the enclosed surface by the use of timber and of concrete; and 3rd, to ensure the distribution of the superincumbent weight over the whole surface of the platform, by the use of wide footings and of inverts. Sir R. Smirke executed successfully some foundations on the soft alluvial mud of the Thames, by the use of an exceedingly thick bed of concrete; but in these instances the mud was so confined, by some ancient river walls, as not to be able to spread laterally.

On peaty subsoils, the principal danger arises from the unequal compression to which they may be, or become, exposed; for if a building were erected on a platform resting upon peat, and the weight of the building were evenly distributed over its surface, it would, in all probability, subside evenly until it had attained the degree of compression required to resist the load. But if a greater load than that of the building were subsequently to be laid on the peat by the side of the original load, the peat would be compressed under the new effort, possibly to such an extent as to overthrow the first building. In fact, if some means of carrying the walls of a building down to the solid substratum beneath a peat bed be not resorted to, or the space between the footings and the solid substratum be not filled up with concrete, it is indispensably necessary that the whole of the seating of the building should be isolated from the surrounding ground by means of close sheet piling, so as to prevent any lateral movement.

In the case of foundations upon running sands, there is no choice left to the architect beyond that of piles or of cylinders, to be subsequently filled in with concrete. In both cases great precautions must be taken to ensure the connexion between the artificial foundations and the resisting substrata, and to protect them from any tendency to lateral displacement by cross-bracing, if possible, or by upper platforms. The load of a building must, in fact, never be brought upon a running sand, however it may be temporarily enclosed; and the artificial foundations used must not be exposed to turn upon their edges under the action of any movement in the sands themselves. COMPRESSION; CYLINDER; FILLING-IN.

The introduction of Mitchell's screw piles has greatly facilitated the execution of foundations in certain uniformly resisting strata.

GAUTHY, *Œuvres*, by NAVIER, 4to., Paris, 1809-13-16; LESAGE, *Recueil—Extraits—des Ponts et Chaussées*, 4to., Paris, 1810; POIREL, *Mémoire sur les Travaux de la Mer*, etc., 4to., Paris, 1841; RONDELET, *L'Art de Bâtir*, 4to., Paris, 1852; SGANZIN, *Leçons d'un Cours de Const.*, 4to., Paris, 2nd edit., 1852; *ARCHITECT Journal*, ii, 50, 62, 92; DOBSON, *F. and Concrete Works* (Weale), 12mo., London, 1850. G. R. B.

FOUNDATION STONE. In former times it was usual for the person who commissioned the erection of a large building to lay, or assist in laying, the first stone of the work: and in mediæval times it was not unusual for him to obtain the presence of wealthy friends, each of whom presided at the deposit of the first stone of some portion of the edifice, and placed thereon a contribution towards the expense of the work. In later times the use of brick, for the parts not afterwards visible, and the number of spectators, have led to the habit of delaying the ceremony until the works are somewhat above ground; and the stone, inscribed, or prepared to receive an inscribed plate, etc., recording the date of erection and other details of the event, is more suitably called the *foundation stone* than the *first stone*, although the latter name is still sometimes applied to it: it is called the foot-stone in ANDERSON, *Constitutions*, 4to., London, 1784, 116, 137, 152, 159, 218, 313; which together with LAURIE, *History*, etc., 8vo., Edinb., 1859; and PRESTON, *Illustrations*, 14th edit., by Oliver, 8vo., London, 1829, p. 83, may be consulted for the practices observed by the present Society of Free and Accepted Masons, when it has occasion to lay a foundation stone for a building belonging to that body, or takes part in the ceremony with regard to other structures. The *BUILDER Journal*, 1858, viii, 436, relates the useless attempt made by the duke of Athol to prevent the Prince Consort, unless affiliated to that Society, from laying the foundation stone of the National Gallery of Art at Edinburgh; and, xix, 796, of other public buildings in 1861. The writers above named correctly repeat the mediæval tradition, as observed at Croyland, that the north-east corner of the edifice was considered the most proper place for the first foundation stone when several were laid.

In early times it was literally the first stone of the structure, as appears from the description given by TACITUS, *Hist.*, iv, 53, of the ceremony observed 21 July A.D. 70, when the rebuilding of the triple temple in the Capitol at Rome was commenced. Even in those days it was not perhaps unusual to place upon it some record of the event and of the principal persons connected with it; thus the foundation stone of the portico of Minerva in the same city, which was laid by Quintus Cæcilius Metellus about B.C. 10, received the inscription commencing 'Lapis auspiciatu saceratus' preserved in GRUTER, *Corpus Inscr.*, fol., Amsterdam, 1707, xxxix, 5, which, moreover, gives the information that it was (*conjectus in fundamenta*) dropped into the trenches. Both these cases are cited in the *ARCHÆOLOGIA*, 1836, xxvi, 216, by DOUCE, *On the Foundation Stone of the Original Church of S. Mark at Venice* (828-9), with some interesting remarks on the ceremony of laying the foundation stones of ecclesiastical edifices. The

account given by P. BLESSENSIS, *Continuatio in Historiam Ingulphi*, edited by GALE, *Rer. Anglie. Scriptores*, fol., Oxford, 1684, i, 119, of the proceedings in laying 7 March 1113 several foundation stones for the church of the abbey at Croyland, is minute enough to serve as a model at the present time, when the foundation stone is frequently made a sort of altar for oblations: a translation will be found in GOUGH, *History of Croyland*, given in NICHOLS, *Bib. Top. Brit.*, 4to., London, 1790, iii, 45 and 88; and in DUGDALE, *Monasticon*, fol., Lond., 1819, ii, 100.

DOUCE also quotes HOSPINIAN, *De Templis*, fol., Zurich, 1603, p. 73, for a notice of the events which that author has taken from BRUSCHIUS, *Chronologia Monasteriorum Germanie*, 4to., Sulzbach, 1682, p. 469 and 236, as occurring at the commencement 1377 of the church of All Saints at Ulm, and 1436 of the monastery at Gnadenberg.

LLAGUNO, *Noticias*, 4to., Madrid, 1829, i, 126-7, quotes what he calls the *acto de posesion* given with a doubloon of gold to the maestro-mayor or architect on the occasion of laying 8 June 1485 the first stone of the capilla mayor to the cathedral at Calahorra: the document is curious and perhaps unique. The first stone of Henry VII's chapel at Westminster was deposited 24 January 1502, the inscription is given in HOLINSHED, *Chron.*, fol., London, 1808, iii, 529-30.

DALY, *Revue Générale*, 1857, xv, 219, notices that the musée de Cluny possesses the copper plate found in the foundations of the pont S. Michel at Paris, stating that it was deposited 21 September 1617 by Louis XIII.

ELLIS, *Original Letters*, 8vo., London, 1827, iii, 271, has preserved a record that in September 1632 'Her Majesty with her owne hands helpt to lay the twoe first square corner stones, with a silver plate of equall dimension between them, in the foundatione of her Capuchins church intended to be built in the tennis court yard of Somerset House', with the subjects of the engravings on the two surfaces of the plate.

PATTE, *Mémoires*, 4to., Paris, 1769, p. 324, describes the ceremony observed in laying 17 October 1665 the foundation stone (which appears to have been 18 ins. cube) of Bernini's work at the Louvre.

The *Extracts from the Records of the City of London, etc., respecting the Royal Exchange 1564-1825*, fol., London, p. 80, mention the visit of Charles II to that building 23 October 1667, when he 'fixed the first pillar—which is that standing on the west side of the north entrance', with his present of £20 to the workmen; the visit of the duke of York 31 October, when he 'fixed the pillar on the east side that entrance'; and the visit of prince Rupert 18 November, when he 'fixed the pillar on the east side the south entrance.' The ceremony of laying the first stone, 17 January 1842, of the present building, is given in the *Reports of the Court of Common Council*, presented 19 January 1843.

The ceremony of laying a foundation stone has been somewhat imitated by railway and other companies when securing the presence of some eminent person to 'turn the first sod.'

FOUNDING (It. *fusione*; Sp. *fundicion*; Fr. *fonte*; Ger. *geisserei*). The operation of fusing, or bringing into a fluid state, metals, which are subsequently run into moulds of definite forms. Whatever may be the nature of the metals, the details of founding them are substantially the same; for they consist, 1, in making the moulds; 2, melting the metals; 3, in filling the moulds with the molten metals; and 4, in trimming the castings. The modifications of detail required in the treatment of the different metals will be noticed at the end. CASTING.

1. In founding iron, the molten metal may be obtained either directly from the ore by the blast furnace, or, according to modern practice, by means of a second melting in the cupola, although strictly speaking the term 'founding' would seem to be more correctly applied to casting with second runnings, and the term 'smelting' to the operation of obtaining the iron from the ore by first runnings. Indeed, although in many

iron works heavy castings are obtained from first runnings, and under some circumstances very fine castings are also thus obtained, the bulk of the metal extracted from the ore is run into what are known by the name of 'foundry pigs', which form the basis of the operations of ordinary castings when mixed with the scrap or plate iron of commerce: the peculiar properties of pig iron, and of scrap, have been noticed, *s. v.* Cast Iron. However the molten metal may be obtained, the moulds into which it is poured are formed either of sand or of loam. For girder castings, iron railings, and ordinary castings, wherein the smoothness of face is a matter of small importance, or in which the profiles of the outer and inner surfaces cannot be obtained by the revolution of a template revolving on an axis, the model is made of wood, usually of fir or pine, or occasionally of mahogany; and this model is laid in the sand forming the floor of the large covered 'hall' of the foundry. The sand, which is of a fine loamy and rather tenacious character, mixed with a portion of fine coal dust, is well rammed against the sides and into the depressions of the model; and then a flask, or a species of open cross barred box, is laid over the upper face of the model, and sand is carefully rammed into its various parts. The flask being removed, and the model itself taken out of the sand in the floor, the exposed surfaces are carefully worked to produce an exact counterpart, in reverse, of the model; and the skill of the founder principally lies in the perfection with which he can produce a fine close surface in his sand mould, able to resist the action of the molten metal without deformation or 'blowing'. The mould in this state, when the two portions are placed over one another, presents a cavity equal to the wooden pattern or model; and the molten iron, when poured through the 'runners', takes precisely the form of the cavity so left, provided the metal be of the requisite quality and temperature, and the face of the mould properly made. Open sand castings are those which are obtained without the use of the upper flask. As cast iron shrinks in length and width in the proportion of about 1 in 100, between the point of fusion and the ordinary temperature of the air, attention must be paid to this law in preparing the pattern, which is ordinarily set out by a scale one-eighth of an inch in a foot longer than the casting is intended to be.

In loam castings, which are usually hollow, the mould is formed by covering a core, formed either of brickwork or of wrought iron, firstly with a rough rendering coat of loam mixed with extraneous ingredients for the purpose of giving it great tenacity; and secondly with a finishing coat of pure loam. The outer portion of the mould is formed in a similar manner. The two portions thus formed are dried in a stove, in order to drive off the water used in rendering the loam plastic. The dried mould is finally buried in the sand, and the iron is poured into it when in that position. In fine castings, such as stove fronts, etc., the mould is dusted with black lead from a vessel resembling a flour dredger. Pipes, cylinders, evaporating pans, cockles for dyers, water troughs, and such articles, are usually cast in loam.

2. The metal is melted, in ordinary foundries, in cupolas, (or cast iron cylinders, or polygonal frames), which are carefully hooped, so as to limit the expansion, and lined with fire bricks set in fire clay, subsequently rendered with road drift of a pure silicious character, in such a manner as to cut off the direct action of the intense heat of the interior of the furnace from the external iron plates. The fuel used in England is generally smothered coke, except in the preparation of iron for the purpose of being tinned, when charcoal is employed, a material also extensively used in some parts of Sweden, and of Germany. The activity and the intensity of the fire, in all cases, is increased by forcing through the fuel a strong current of air, produced either by the draught of a lofty chimney placed over the cupolas, or by a fan revolving at great velocity blowing either heated or cold air through the cupola. The metal is thrown into the cupola, and the orifice through which

the hot metal is to be drawn is closed when the whole body of the cupola has become thoroughly hot; and in about twenty minutes the iron will begin to fall through the fuel into the basin of the cupola, if the latter be well built and properly worked. The molten metal accumulates in the bottom of the cupola until the whole charge has been run down, and the tuyère holes (through which air is introduced by the fan) are filled up as the metal rises, for the fresh blast must never be allowed to come in contact with the molten metal, but it must be introduced at the lowest part of the incandescent fuel; when the whole charge is down, the lower front orifice of the cupola is *tapped*, and the iron is run either into ladles or into sand channels leading to the runners of the moulds. For a description of the methods of employing heated, or cold air, for these purposes, see BLAST; COLD BLAST.

The character of the metal 'to be put up', as the foundry men say, depends upon the nature of the work to be executed; this subject has been treated, *s. v.* CAST IRON.

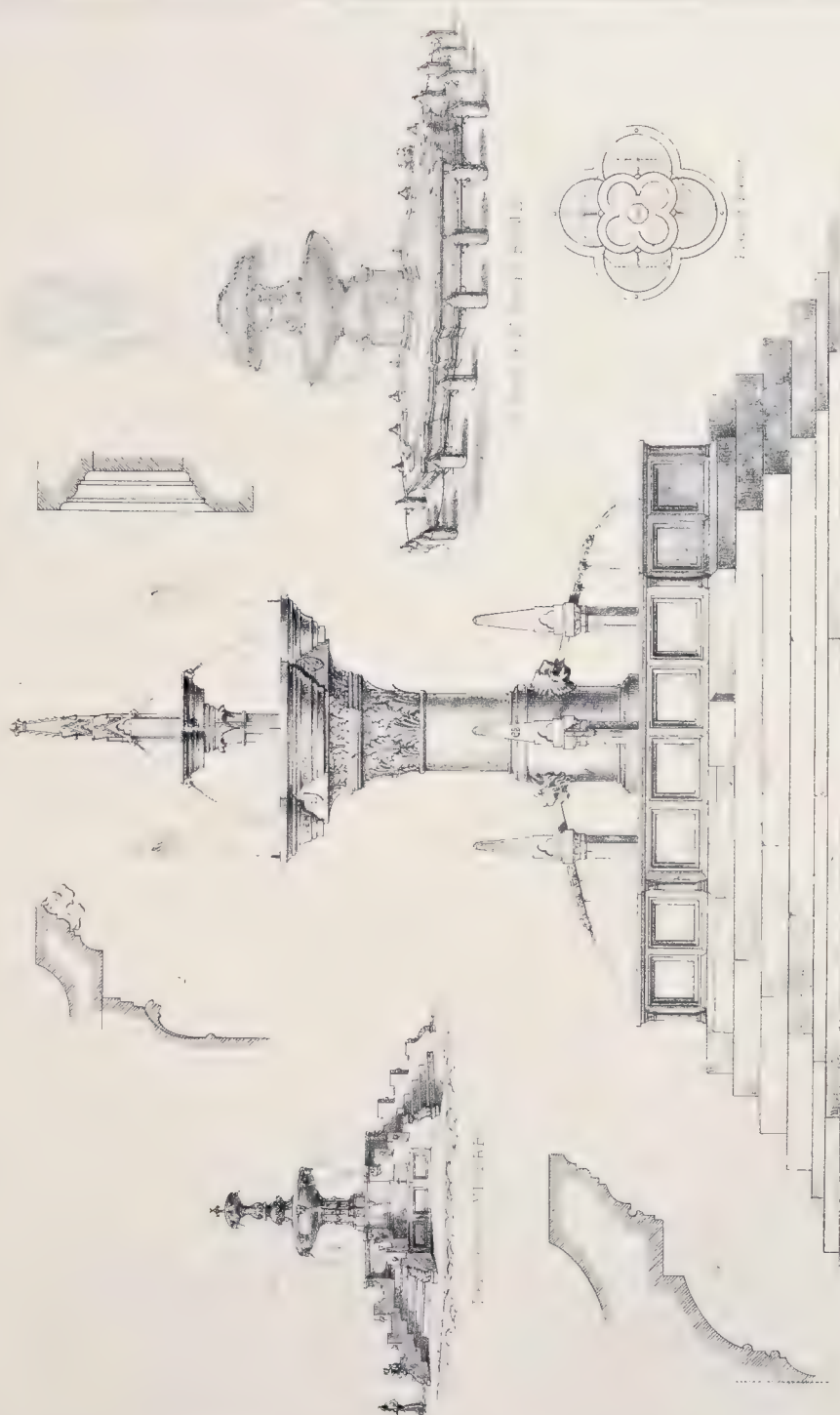
3. The metal, as was before said, runs from the cupola into ladles, or large iron vessels lined with loam; or into troughs formed of sand, when the casting can be made in the floor near the furnaces, and is to be of great dimensions. It enters the mould through channels called runners, leading to the hollow space left by the withdrawal of the model or pattern; and when it is desired to ensure a perfect soundness in the casting, the metal is fed through the runner for some time. If the length of the casting should be very great, the metal may be poured in through two or more runners, as already noticed *s. v.* CAST IRON.

Great precautions must be taken to ensure the escape of the hydrogen gas, or the other gases, given off by the mould upon the contact of the hot iron with the sand or with the loam of which it is made. This is effected by means of pipes leading from the hollow space, or by a series of small holes left in the sand of the flask; the gases as they escape are usually set on fire, and they continue to burn until the metal begins to cool and to crystallize, or set, in the mould. If the casting should be of such a description as to present masses of metal of unequal volumes, it may be necessary to uncover the larger portions at once, in order to expedite their cooling, and thus to cause it to advance *pari passu* with that of the smaller masses; much of the success of complicated castings depends, in fact, upon the skill with which the cooling is regulated, a most important point, preventing warping, etc. In some cases advantage is taken of the flexibility of a still hot casting to bend it to any desired sweep, and thus to obtain a circular casting from a straight mould.

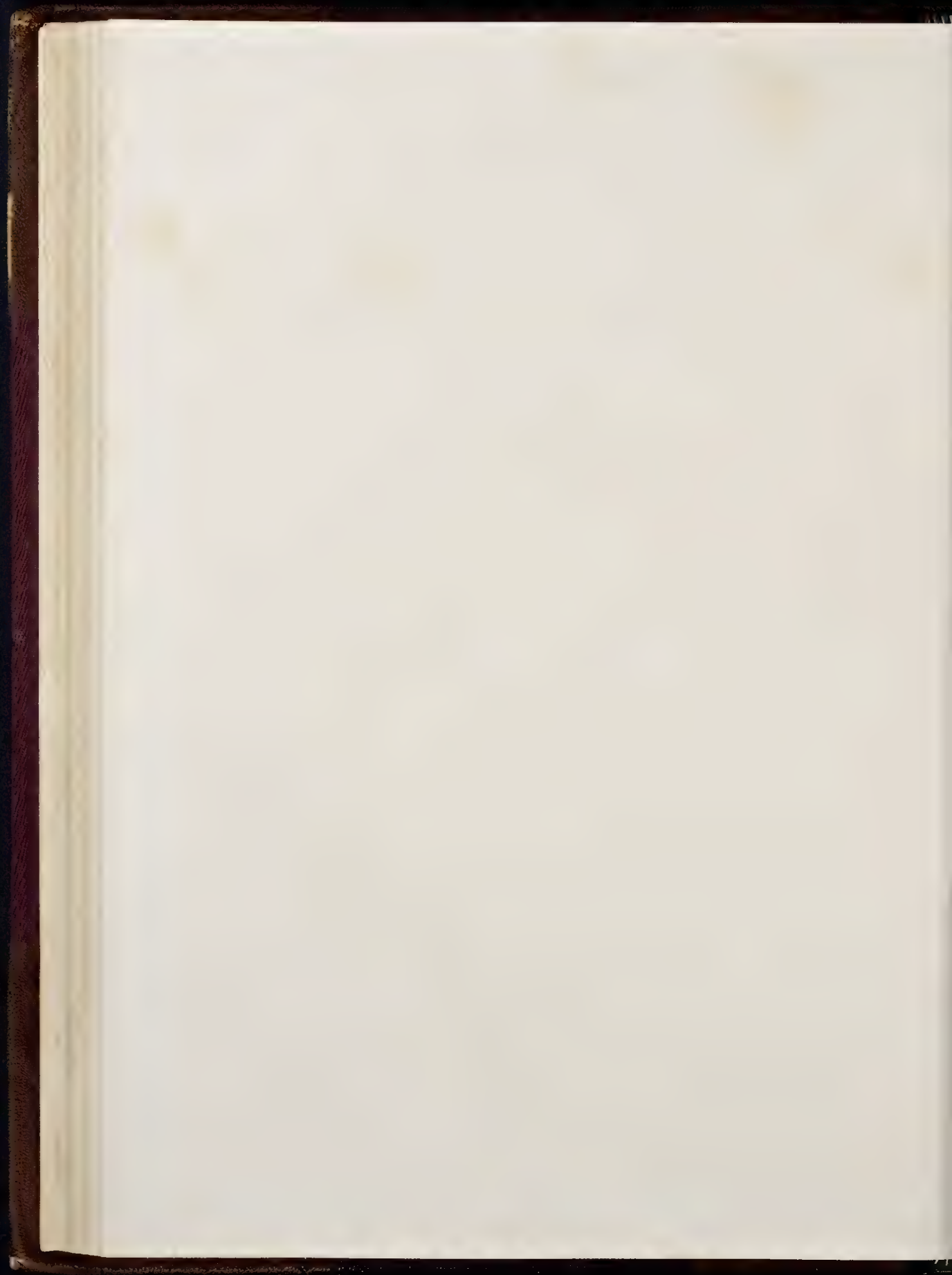
It may be added that cupolas are seldom able to melt more than the quantity of metal required for producing a casting of four tons weight. The ladles used rarely contain more than a ton at a time; and they range in dimensions between such large crane ladles to the small hand ones containing about a quarter of a hundredweight each. When a casting is so large as to require the use of two furnaces, great attention must be paid to ensure the perfect identity of the metal, and the equal degree of temperature as the separate portions enter the mould; and that no sand or scoria should float on the surfaces, as it will deposit where the streams of molten iron meet, and form a sort of vein between them, which will cause a 'short casting'; and even if this does not occur, there may be a 'cold shut', as noticed *s. v.* CAST IRON. If particularly sound castings should be required, as in the cases of water or gas pipes, steam cylinders, or pump barrels, the mould should be placed vertically, in order that the fluid metal may force itself equally, by its own gravity, into the mould. Castings of this kind are run from the top.

4. The operation of trimming consists in removing from the surface of the casting the burnt sand of the mould, the burrs which almost always are found upon the edges where the two portions of the mould touch, the runners, and any 'blows', or

FOUNTAIN



THE FOUNTAIN, PA. PUBLISHED BY THE SOCIETY



FOUNTAIN.



Villa Albani ROME.



"Tartarughe" ROME.

182 S. H. Newman L. R. A.



FOUNTAIN



Fig. 1



Fig. 2



Fig. 3



Fig. 4



Fig. 5

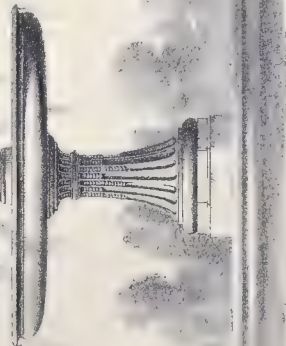


Fig. 6

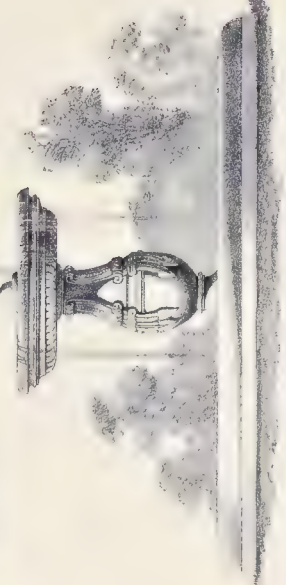
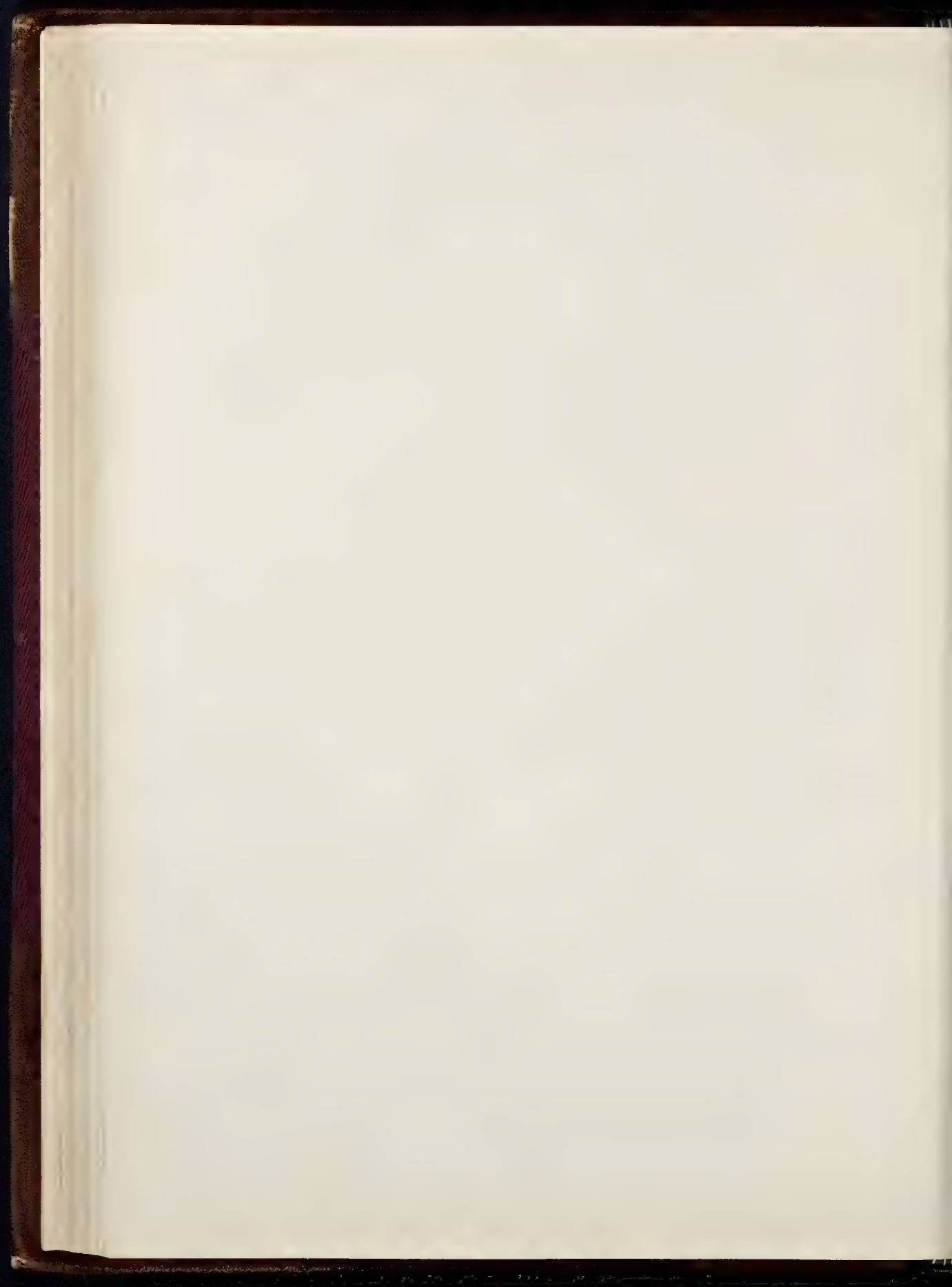
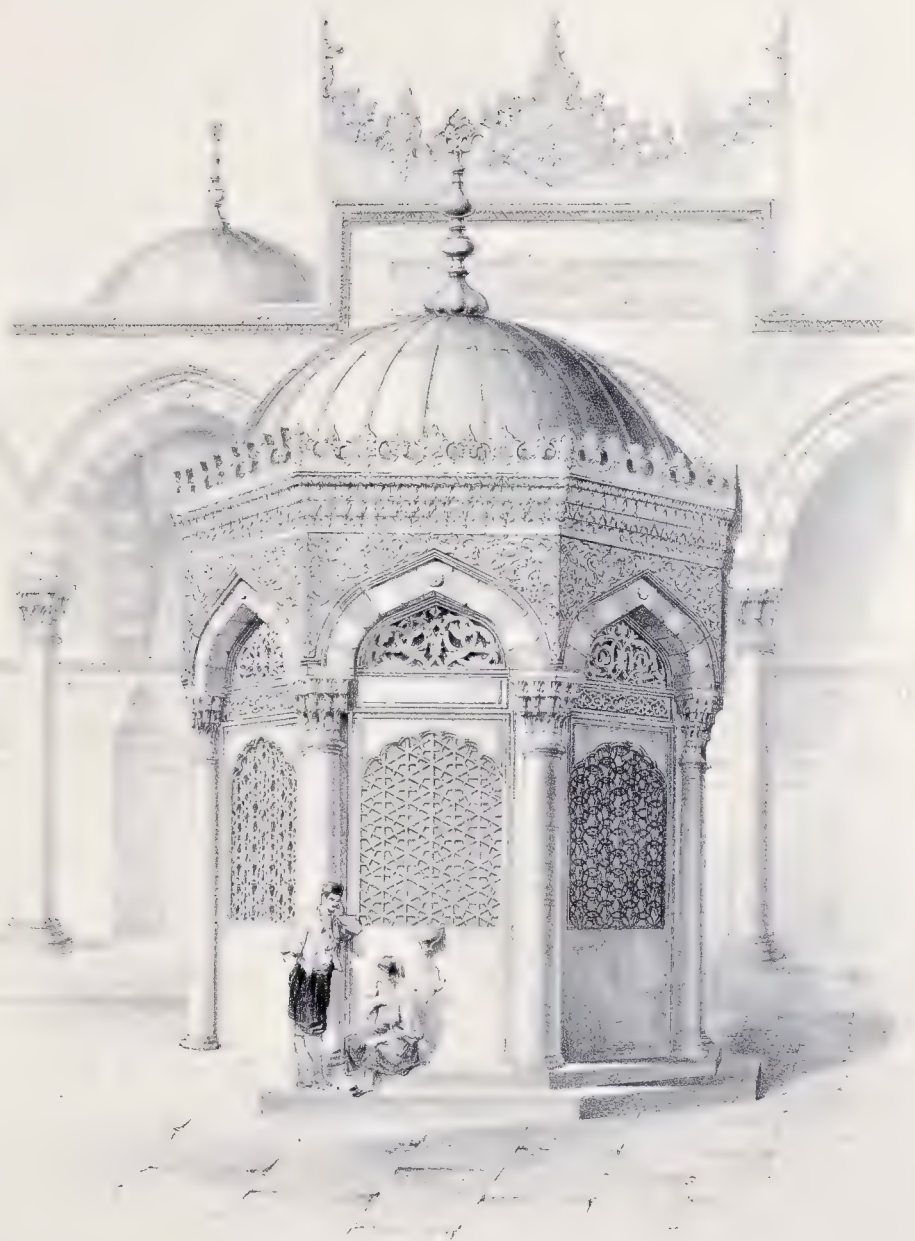


Fig. 7



FOUNTAIN.



In the Court of the Mosque of the
Sultana Valides, STAMBOUL

John W. Walton, MIBA

Lithographed for the Society by Kell Bro^s March 31st 1862



additional metal upon the surface in consequence of any defect in the mould. These excrescences are removed by the hammer, chisel, and file, or by an iron wire brush; but if it be required to remove all the impurities from the face of a casting the latter is 'pickled', i.e. washed with (or immersed in) dilute acid, which leaves the metallic face perfectly clear. The operation of trimming is purely mechanical, and is usually confided to the lowest class of workmen in a foundry.

Of late years the practice of moulding pipes by machinery has been carried to a great extent in the north of England; but the quality of the goods, sold by the manufacturers who have adopted that system, is so very unsatisfactory that the system itself is likely to suffer in public estimation.

Brass, the alloy of copper and zinc, is almost exclusively used for the preparation of sheet or of wire; and the mode of casting it is not of sufficient importance to the architect to require notice. The casting of gun metal, of bell metal, and of bronze, is accompanied by some changes of detail, in the mode of preparing the moulds, and in the treatment of the metals, which are of great interest and importance. Thus in the founding of gun metal, it is essential not to expose the copper and tin to such a degree of heat as to volatilize either of those metals, or the small proportions of zinc or of lead which are sometimes added; and as the castings are usually small, the air furnace is the only one used. In casting statues, or in bell founding, the quantities of metal to be melted are so great that it becomes necessary to resort to the use of the reverberatory hearth, or to an artificial and a forced ventilation produced by the fan acting upon a cupola; and, indeed, the processes of moulding or of casting adopted in these cases differ so little from those used in the more complicated descriptions of iron loam castings, that the observations made upon the latter will, *ceteris paribus*, apply to the former. The great art of the statue and bell founder is to secure the perfect mixture of his metals, and their extreme fluidity at the moment of their entering the moulds; it is on account of the necessity for attaining these conditions that the reverberatory furnace is resorted to, for in it the metals can be partially protected from contact with the atmosphere, the effect of which would be to produce a combustion of the copper and an oxidation of the tin. In fact the cupola should never be resorted to for obtaining bronze castings in cases wherein the quality of the metal is an object of importance. **ALLOY.** DE REAUMUR, in *Description des Arts et Metiers*, fol., Paris, 1761-89; ROGERS, *Iron Metallurgy*, 8vo., 1840; MUSHET, *Iron and Steel*, 8vo., 1840; SCOFFERN, *Metals and their Alloys*, 8vo., 1857.

G. R. B.

FOUNDRY. An establishment wherein the operations of

casting brass, lead, copper, or iron, are performed; the casting of the metal itself being known by the term **FOUNDING**. The subjoined sketch illustrates the general arrangements of a well organized foundry, able to turn out about thirty tons of castings per week of six days.

The North Workside

Iron Works foundry, erected by John Downie of Glasgow in 1852, is given in the *CIVIL ENGINEER Journal*, xx, 177, pl. 16; in which is also shown the improved application of iron to structural purposes, where great lateral strains have to be resisted, such as are occasioned by the action of powerful lifting cranes.

G. R. B.

A foundry at present is frequently nothing but a large open shed, covering a 'jenny' scaffold and travelling cranes, etc.

FOUNDYNG (WILLIAM) is mentioned in the *Fabric Rolls*

ARCH. PUB. SOC.

of Exeter cathedral, 1396-7, as a freemason engaged at the yearly wages of 26s. 8d.; BRITTON, *Exeter Cath.*, 4to., Lond., 1827, p. 96. This is the earliest instance known of the use of the word 'freemason'.

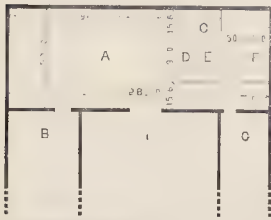
W. F.

FOUNTAIN. The name formerly applied to a CONDUIT or cistern, containing a supply of water, discharged either continuously or intermittently, for public or private use; such as the castellum of the Romans (*Illustrations*, s. v. Aqueduct), the It. *castello d'acqua*, the Fr. *chateau d'eau*, and even the Fr. *borne*, and the drinking fountains lately erected; for, where the supply is artificially conducted whether in a channel or in a pipe, the cistern may be situated at any part of its passage. The term was also injudiciously employed to designate a flow of water, whether natural or artificial, such as the cascades of some celebrated gardens. The hydrostatic principles connected with fountains, the arrangement of the pipes, etc., to ensure the utmost effect of water, etc., is given in CHAMBERS, *Educational Course, Hydraulics*, etc., 8vo., Edinb., 1840; RAMBUTEAU, *Compte rendu, Année 1836*, 4to., Paris, 1837; or *Rapport—au Conseil Municipal de la Ville de Paris*, 4to., Paris, 1834; AUBUISSON DE VOISINS, *Traité d'Hydraulique*, 2nd edit., 8vo., Strasb., 1840. **HYDRAULICS.**

The word at present implies a stream, whether continuous or intermittent, rising into the air (Fr. *jet d'eau*), either naturally, as in the case of an ARTESIAN WELL, or artificially, as at Versailles and Chatsworth, and in the group of jets in each of the great fountains at the Crystal Palace at Sydenham. Of this last sort are numerous classes, varying according to the decoration expended upon them, and ascending from a basin with a mere ajutage or nozzle placed just above the level of the water, to a series of basins placed one over the other, each having jets playing in directions to produce desired effects of form and colour. The Italian architects have effectively employed a series of small jets, as shewn in the *Illustrations*, s. v. Blank Wall; and in a very few cases an agreeable result has been obtained in France by enclosing the jet in a sort of shrine. SEEBEL; SOURCE; SPRING. *Illustrations*, s. v. Basin, pl. 115.

The manner in which the FLOW OF WATER has been considered as a means of decoration, will be found in the *Illustrations*, s. v., and some of the following publications. VRIESE or FRISIUS, *Designs* (Early German), 4to., Antv., 1568; DIETTERLIN, *Architectura* (Early German), fol., Nürnberg, 1598; both works very rare; DE LA FOSSE, *Ornamental Designs*, fol., Paris, 1768, rare; PARASACCHI, *Raccolta delle principale F. di Roma*, 4to., Rome, 1637; FALDA, *Le Fontane di Roma*, fol., Roma; and *Le Fontane delle Ville di Frascati*, etc., fol., Roma, both before 1685; LE BRUN, *Desseins de F.*, etc., fol.; GIRARD, *Recherches sur les eaux publiques de Paris*, 4to., Paris, 1812; DUVAL and MOISY, *Les F. de Paris*, fol., Paris, 1812, new edit., 1859; SCHEULT, *Recueil d'Arch. en Italie*, fol., Paris, 1821; AUBUISSON DE VOISINS, *F. de Toulouse*, 8vo., Paris, 1839; DARCY, *Les F. Publiques de Dijon*, 4to.; ALLGEMEINE BAUZEITUNG, ser. 1, pl. 94, 137, 235, 631-7 (in ser. 2, pl. 530, etc., are the conduits of Constantinople); NORMAND, *Paris Moderne*, 4to., Paris, 1843; part 2; LETAROUILLY, *Rome Moderne*, pl. 168, 172, 187, 231; DALY, *Révue Générale*, xvi, gives in pl. 13, etc., *Déplacement de la F. du Palmier, place du Chatelet*; HITTORFF and ZANTH, *Arch. Moderne de la Sicile*, fol., Paris, 1825. Examples in Gothic architecture are given in NODIER and TAYLOR, *Voyages Pittoresques*, passim; GAILHABAUD, *L'Arch.*, etc.; VERDIER and CATTOIS, *Arch. Civile*, etc.; VIOLETT LE DUC, *Dict.*

FOUQUET or **FOUCQUET (JEHAN)**, who received 6 sols 3 deniers per diem, was one of the 'massons qui font le corps de la grant maison' at Gaillon from October to December 1504; Senault, the chief mason, received 7 sols 6 deniers per day; and the next highest mason only received 4 sols 6 deniers per diem. Fouquet is mentioned by DEVILLE, *Comptes de Dépenses*, 4to., Paris, 1850, p. 81, as having been paid his expenses for going to Rouen to survey the works in hand for his patron, the



A, 'The casting pit, 10 ft. deep; B, Trimming shed; C, Iron stove; D, Furnaces or cupolas; E, Pig mould; F, Hot box; G, Steam power engine; H, Loan shed; I, Pig and iron shed; J, Open yard, and proving ground for girders, &c.'

cardinal George d'Amboise; and in 1507 as being, with Fain and Senault, one of the contractors for building the kitchens at Gaillon.

FOUR CENTRED ARCH. The name given to any arch formed by portions of four circles; but usually restricted to an arch formed by the junction of two circles, having their centres on the line of springing, with two others whose centres are more or less below that line, and more or less distant from the vertical central line of the opening. As there is some difficulty in finding the centres where the openings, height of haunch, and apex differ, problems for describing them have been given in the last (eighth) edition of the *ENCYCLOPÆDIA BRITANNICA*, art. *Stone masonry* (medieval), p. 733, which much facilitates the designer. WATSON, *On Drawing Four-centred Arches, as deduced by Tredgold*, paper read at Royal Inst. Brit. Archts., 1840; LAKER, *On the Curve of Gothic Architecture*, read before the Liverpool Arch. Society, 1850, and partly given in the *CIVIL ENGINEER Journal*, xiii, 365.

FOURNEAUX STONE, obtained from a quarry near Saumur, was used for the columns of the church (*style ogival première*) of All Saints at Angers, their height being 25 ft. 7 ins., and diameter nearly 12 ins.; WARE, *Tracts on Vaults*, 8vo., London, 1822, 25, who adds that a cubic English foot, of this stone weighs 2,571 oz., and that a cube of 1'968 Engl. ins., was crushed by 386,000 oz.

FOURNIER (. . .), with Plain, has the credit of designing for Henri IV (1590-1600) the upper story of the little gallery of the Louvre, according to SAUVAL, *Description*, fol., Paris, 1724, ii, 37, whose authority, however, is doubted in the vague description of that portion given by CLARAC, *Musée*, 8vo., Paris, 1841, 352 and 651.

FOURWAY COCK. A valve, employed to regulate the discharge of liquid from a pipe. It consists of a plug, perforated with two distinct passages curved on plan, mounted in a barrel that receives four separate pipes; the object of this contrivance being to connect each of the four passages alternately with one or the other adjoining one at pleasure, or to close them all at once. 14.

This is much used at the different baths and washhouses for the washing boxes, and serves for hot and cold water, steam and waste. **THREWAY COCKS** are generally used for the baths, both public and private, and are turned by a handle with an index pointing to a plate, engraved with the words, hot, cold, waste, and shut. It is a question, however, whether the use of three and four way cocks, by which the clean water is admitted to a bath or basin by the same orifice as the foul water escapes from, is desirable. There is invariably an accumulation of soap below the rose grating which contaminates the fresh water.

FOUSURA, see **VOUSOIR**.

FOWL HOUSE (Fr. *poulailler*; It. *gallinaio*). A shed or division of a shed for keeping poultry. It should have a south or south-east aspect, and if connected with farm buildings its best place is near the boiling house: should a steam-boiler be used on the premises, the outlay of warming the fowl house by steam or water would be repaid by the increased number of eggs and greater success in rearing chickens; warmth being essential in both cases. It should be lofty, well ventilated, and dry, with moderate light; paved with stone, laid on concrete having broken glass mixed with it, to keep out rats; the roof should be of tiles or slates, or of stones of large size. The walls and the roofing inside, as well as all the fittings, should be frequently limewashed to destroy insects. The boxes for the nests, formed of wood, and stone or slate sides, are best arranged in tiers, each being 15 ins. cube, the lowest range being 24 ins. cube, not placed against the walls, but having a passage behind so that the nests can be inspected by means of a door at the back of each nest without disturbing the birds. Perches for roosting should be arranged over the centre of the house, thus leaving the top of the nests and passage

round them clean; one perch should not to be placed immediately below another; and a sparred ladder is useful on each side for the shelves. When fowls of different breeds are kept, each species must have a distinct house and yard; but the whole set may be combined around a central chamber containing the food store, a stove, and implements for cleaning, etc., and thus it may be made an ornamental feature adjoining a country residence. Yards, when required, should be paved as described for the fowl house and well drained; a small shed or covered corner being also provided for shelter. MORTON, *Encyclopædia*, 8vo., London, 1855, i, p. 808; STEPHENS, *Book of the Farm*, 8vo., London, 1851, i, p. 661, describes a room with smaller rooms out of it, as comprising the 'hatching house'. **Duck House.** **PIGEON HOUSE.**

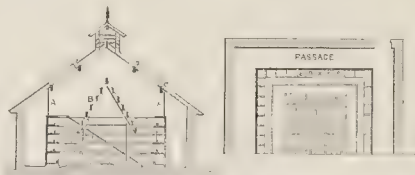


FIG. 5. PLAN OF PORTION OF A HOUSE. A, Fowl house; B, Passage; C, Stove; D, Room; E, Passage; F, Room; G, Passage; H, Room; I, Passage; J, Room; K, Passage; L, Room; M, Passage; N, Room; O, Passage; P, Room; Q, Passage; R, Room; S, Passage; T, Room; U, Passage; V, Room; W, Passage; X, Room; Y, Passage; Z, Room; A. H. M.

FOX (LOUIS DE), see **FOIX (LOUIS DE)**.

FOX AND BARRETT'S FIREPROOF CONSTRUCTION. The patent was granted Feb. 10, 1844, to Dr. Fox, who first carried out this system, 1833-4, at his asylum at Northwoods in Gloucestershire. The floors and roofs are formed by a combination of joists of wrought or rolled iron, the spaces between them being filled in with concrete, on battens to form the ceiling; each floor is said to thus become a beam of artificial stone with ribs of iron, fireproof in its nature, and adapted to receive a finished surface either of ordinary floor boards, or of cement, asphalt, tiles, slates, etc. The patentees published *Construction of Public Buildings, etc.*, 12mo., London, 1849: its merits were largely discussed at the Royal Institute of British Architects, as given in *Transactions*, 1853-4, p. 36-74; and noticed in *CIVIL ENGINEER Journal*, vii, 322; xi, 359; *BUILDER Journal*, xi, 390; *PRACTICAL MECHANIC Journal*, ii, 257; and other publications, as stated in **FLOOR, FIREPROOF**, No. 8.

FOXTAIL WEDGING, also called **FEATHER WEDGING**. A method of fixing a tenon in a mortise, which does not go through the whole stuff, and therefore is not accessible on the outside, and is performed by dividing the end of the tenon and inserting a wedge; the wedge at first is only driven partly home, and when the whole is put into place the bottom of the mortise, resisting the wedge, forces it further into the tenon; in either case the tenon is caused to be firmly compressed by the sides of the mortise. To guard against the liability of the tenon to split beyond the shoulder, the required effect would be better sought by the use of several thin wedges.

FRACTABLE, or **FRAC TABLE**; **FACTABLING** at Liverpool. A term used, in the middle ages, for the **CREST TABLE** or coping running up and down the gables of a building. The curved portions were called 'bottles'; thus half a gable may consist of a foot-table at bottom, a bottle, a square, and a top or crown bottle, according to HOLME, *Academy*, fol., Chester, 1688, iii, 111; or of a foot-table and three bottles, as shewn in Fig. 5, in *Detached Essays*, s. v. **Brick Gable**, where other larger examples are given. The word is still used in the west of England. **FOOT-TABLE.**

FRACTURE. The breaking of any substance by a violent effort. The dynamical conditions under which it takes place constitute a very important detail of the laws of the **RESISTANCE OF MATERIALS**. In relation to timber, the question of fracture is of less consequence than the strain which may destroy the elastic force, and that is the only one to be relied

upon for practical purposes. The word fracture is, however, nearly as often used to designate the appearance of a body after its surfaces have been violently torn asunder, as it is used to express the action of breaking; and it is in this sense that it is to be taken in the books upon lithology and mineralogy. Thus metals are said to have either a dull or a bright fracture, according to their colour or brilliancy; the fracture is called either crystalline, laminar, lamellar, fibrous, conchoidal, hackly, even, or uneven, according as it may be characterized, 1, by the distinctness of the facettes of its component crystals; 2, by the distinctness of its parallel beds when they are of considerable thickness; 3, when those beds are extremely thin; 4, by the filamentary character of the cross section; 5, by the spherical shape of the elevations and depressions of the surface; 6, by the unevenness of those elevations and depressions; 7 and 8, by the greater or less degree of smoothness of the surfaces of fracture. Stones break with an earthy or a crystalline fracture, or they are said to have laminar, lamellar, conchoidal, even, or uneven surfaces, as before described. The fracture of the blue lias stone may be cited as an illustration of the conchoidal fracture; that of the Yorkshire flags or of slates, as illustrations of the laminar structure; the fracture of mica is coarsely lamellar; that of marble is crystalline and uneven; that of amorphous limestone is earthy and partially even. The fracture of cast iron is crystalline and hackly; that of wrought iron is often fibrous; but in the best varieties, such as the Swedish or the charcoal iron, the fibrous fracture is barely distinguishable, and it gives way to a very fine and even crystalline one. When there is much sulphur in cast iron the crystalline fracture assumes a radiated appearance, starting from the centre of the mass. JAMIESON, *Characters of Minerals*, 8vo., 1817. A. R. B.

FRAME (Fr. *assembler*). To put pieces of woodwork together. It also seems to have signified the work so formed, as the rough timberwork of a house when dwellings were entirely or chiefly of timber: thus, besides the Statute 37 Henry VIII, c. 6 (1545), against "secret burning or cutting of frames of timber—for houses", HARRISON, in HOLINSHED, *Chronicles*, about 1574, in the chapter 'of the Manner of Building', says "timber frames are supposed to be not much better than paperworke of little continuance." It subsequently was applied to the body of an edifice, whatever might be the materials employed: and lastly it seems to have expressed the design; at least GAGE, *Hengrave*, 4to., London, 1822, p. 41, furnishes no clue to the possibility that either some previous structure, or a drawing, might be the 'frame' which the mason had seen and which he was to follow, 1525, in building Hengrave Hall of brick and stone. The same uncertainty might be suggested with reference to the employment of the word by HARRISON, who in the place above cited speaks of stone structures with "such an excellence of devise in the frames now made"; and also with regard to the instances afforded by SPENSER, *Faerie Queene*, 1589, b. ii, canto ix, verse 21, who says of a castle that "the frame thereof seem'd partly circulare and part triangulare": in b. iv, verse 31, published 1596, he says "I much admyring that so goodly frame, unto the porch approcht." "For framing, making, erecting and finishing" a tomb, appears in 1606, which would intimate designing; while "A brief discourse of all that which ought to be observed in the Framing of every building", being the heading of the introductory chapter to PRICE, *The Art of Fair Building*, fol., London, 1670, an edition of the work by LE MUET; and "the manner of framing (Fr. *construire*) the roofs", p. 29, would both intimate construction irrespective of the mere design. Other uses of the word will be found noted by W. PAPWORTH, in *Builder Journal*, 1859, xvii, 756-7. To these observations may be added that HORMANUS, *Vulgaria*, 4to., London, 1519, p. 240, has the following passage, "a quavery or maris and unstable foundation must be holpe with great pyllys of alder rammed downe and with a frame of tymbre called a cross aundre", this last word evidently means a X or cross of S. Andrew. GRATING of timber.

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FRAME BRIDGE, see LATTICE BRIDGE.

FRAME, of a door, of a window, etc., see DOOR-FRAME, SASH-FRAME, etc.

FRAME TOWER. Wooden campaniles, which are nearly peculiar to the counties of Surrey and Sussex, appear to have received this name: *ECCLESIOLOGIST Journal*, 1849, ix, 19.

FRAMING (Lat. *coagmentatio*; It. *commessura*; Fr. *assemblage*; Ger. *fugung*). The act of putting together pieces of timber or deal by mortises and tenons. The combination of pieces in floors, partitions, roofs, etc., is explained under their several articles. Timber is generally classed under the heads of *framed* (called 'bound' in Scotland) when put together rough from the saw; *wrought framed* when planed also; and *wrought framed and beaded or rabbetted*, as the case may be. The revival of mediæval roofs has now given the items of *wrought framed and chamfered*; and *wrought framed and stop chamfered*. A carpenter's framing is sometimes pinned together, but more commonly secured with bolts, collars, shoes, straps, and ties of iron. A joiner's framing is generally wedged and glued. Sashes are frequently doweled as well as wedged. Framing for external work is better put together with white lead instead of glue. A general outline of the principles of timber framing in bridges, roofs, etc., by S. C. CAPES, read at the Architectural Association 1859-60, is given with illustrations in the *BUILDING NEWS Journal*, iv, 1255-9, and v, 91. TREDGOLD, *Carpentry*; NICHOLSON, *Carpentry*; *Manuel de Charpentier* of RORET's series.

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THOROUGH FRAMING is noticed in NEVE, *Dict.*, 1736, as including the manufacture of the doors and windows with the carcase, flooring, partitioning, roofing, ceiling-beams, ashlar, etc.

The term is also used for a form of SCAFFOLDING.

FRANCA PETRA. A late Latin term for "freestone brought from Caen, and used in the finer kinds of masonry", as noticed by DALLAWAY, *Discourses*, 8vo., London, 1833, 174. In a fabric roll of Westminster Abbey, 37 Henry III, 1253, occurs 'france petre' applied to Reygate stone, and translated freestone by WILLIS, commenting on the roll; 'Came' or Caen stone is also used therein: *BUILDER Journal*, xviii, 655; GENTLEMAN'S MAGAZINE for 1860.

FRANCARD (. . .), although enjoying the rank of architecte du roi, as shewn in the title-page of *Nouvelles Cheminées gravées sur des desseins de M. Francard*, about 1686, is otherwise unknown except by a series of *Portes cochères de Menuiserie*, dating about 1680-5.

FRANCIS D'ESTRICHY (. LE), admitted 1755 a member of the Academy of Architecture at Paris, died 1762.

FRANCH (JUAN) erected the tower (then detached) called el Micalet, of the cathedral at Valencia in Spain, 1381-1418; some writers state 1421. 66.

FRANCHE-BOTRAS. This term is applied by RAINE, *Catterick Church*, 4to., London, 1834, in the Contract for which edifice the word frequently occurs, to a diagonal or corner buttress, which he suggests was "perhaps called franche" (WHITAKER had previously printed it as 'stanche') "from its free salient character, or perhaps from being of French invention." But the Contract supplies this much of positive information, that there was to be "a franche-botras atte the myldwarde of the elyng" where there is now a buttress of a common type; and "a botras on the north-west cornere," where there is now a diagonal one. The GLOSSARY suggests that it probably meant a buttress of free-stone.

FRANCHI (F. . . .) rebuilt 1700 the church (only) of Sta. Maria degl' Angioli at Florence. FANTOZZI, *Guida di Firenze*, 8vo., Fir., 1842, p. 384.

FRANCIA (IL), see RAIBOLINI (FRANCESCO).

FRANCIGENUM OPUS. The collegiate church at Wimpfen im Thal, Bavaria, was built 1262-78, by a clever mason recently arrived from Paris, "opere francigeno". 92.

FRANCINI (ALESSANDRO) of Florence, invited to Paris by

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Henry IV., became engineer in ordinary to the king of France. He published *Livre d'architecture, contenant plusieurs portiques de différentes inventions sur les cinq ordres de colonnes*, fol., Paris 1621, 54 pl.: another edition in 1631; his portrait was given in that of 1637. An English translation was published by PRICKE, *A New Book of Architecture, &c.*, fol., London, 1669.

FRANCISCAN BUILDINGS. The members of the order of mendicants instituted 1209 by S. Francis of Assisi were known not only as Franciscan friars, but as Grey friars, and as Cordeliers or Minorites, and subsequent reforms introduced further distinctions; such were the appellations of Conventuals, given to the monasteries that would not follow the reform; of Recollets (1484); of Observants (1525); of Capuchins (1555); of Penitents, (1601), or as they were sometimes called, les Piepus, from the name of the village next to the faubourg S. Antoine at Paris, where the Tiercelins, or monks of the third order of S. Francis had a house; and of Béguins. The female devotees, regulated 1232, were called nuns of S. Clare, or Minoresses, and Béguines. The rule was so rapidly adopted, that about 1260 the order counted twenty thousand members in 800 houses in thirty-three provinces, as they were called, and in about a hundred years they had increased to a hundred and fifty thousand souls. DUGDALE, *Monasticon*, v, 1501, gives notices of sixty-six houses of Grey Friars formerly existing in England, where they arrived about 1219 or 1224, and divided the country into "custodies," with a provincial over the seven custodes or wardens, one to each district. The tower at King's Lynn in Norfolk (octagonal), and that at Richmond in Yorkshire, which are the chief vestiges of those churches, are perhaps the most noticeable remains. The Minoresses had four houses in England.

VIOLLET LE DUC, *Dict.*, i, 297, does not enter into the subject of Franciscan buildings further than saying that even before the death of S. Francis (1226), his order had wonderfully departed from the simplicity and poverty of his primitive followers; and that, from the thirteenth century, the Minorites established monasteries which were so rich as in no way to yield to the abbays of the Benedictine orders. Yet BRICE, *Nouveau Description*, 12mo., Paris, 1725, iii, 127, noticing the Capuchin monastery in the rue du faubourg S. Jacques at Paris, describes the cloister, after the manner of these fathers, as small and contracted (*petit et serré*). The reason being that the friars were abroad all day preaching or begging, and therefore did not need so large a covered space for exercise in bad weather, as those orders where the rule confined the votaries to the monastic precincts.

It has been observed by the writer of the *Handbook* for North Italy that the Franciscans, like the Dominicans, seem to have adhered to the mediæval style after the revival of classic art: he even insists that the Franciscans, both in Italy and beyond the Alps, employed the Gothic style of architecture more than the other religious Orders, and to which style a traditional reverence might perhaps be paid on account of the example set at Assisi. On the other hand, WEBB, *Eccl. Sketches*, 8vo., London, 1848, p. 495, enumerates as the features of the Capuchin church at Rome, in the modern Italian style which he calls Renaissance, built 1626-31, a nave, a square-ended chancel, lateral chapels screened off from the nave but communicating by a passage with each other, stalls behind the high altar (BACK-CHOIR), as usually the case in the churches of Capuchin monasteries, and a crypt, which is a bonehouse. It would appear from TSCHISCHKA, *Kunst*, 8vo., Vienna, 1836, p. 94, that the church of S. Michael at Pulkau, in Lower Austria, has its nave built "im Capuziner-style," but what that may be does not appear.

MARCHESI, *Lives of Dominican Artists*, transl. by MEEHAN, 8vo., Dublin, 1852, i, 73, says "the Franciscan order, which, in the magnificence of its temples, very often equals and surpasses every other, either for want of architects, or being de-

sirous to avail themselves of extern talent, neither in the thirteenth or fourteenth centuries, as far as I can learn, employed any architect of their own body to erect any edifice of importance"; while "as the Dominicans commonly had architects in their communities, it is likely they would have had recourse to some member of their brotherhood."

DE LASSAULX in WHEWELL, *Architectural Notes*, 8vo., Cambridge, 1842, p. 165, says of one of the four churches at Oberwesel, "the ruins of the Franciscan church display an uncommon construction. A secondary nave has been added, and is separated from the principal nave by pillars placed diagonally. The mutilated Franciscan church at Coblenz, and the one at Andernach, which since the year 1816 has been used as a stable, have the same construction:" and from p. 194 it appears that the latter structure "was erected between 1414 and 1463;" and from p. 180, that the choir alone remains of that at Coblenz.

The most accessible descriptions of a Franciscan monastery are CAYON, *Eglise des Cordeliers*, etc., 8vo., Nancy, 1842; and BRASH, *Friary at Adare*, noticed s. v. Dominican Buildings, to which article throughout, reference may be made. In the latter example the student will find the north cloister, refectory, dormitories, kitchen, with a handsome room over it, and a church, consisting of a nave, central tower, chancel, and south transept ("which generally exists in churches of this order in Ireland," as at Buttevant), with a later western aisle which has a western chapel, and two other chapels on the east wall of the transept. DUTILLEUL, *Hist. de Corporations Religieuses en France*, 8vo., Paris, 1846; BRASH, on *Franciscan Buildings*, in *Transactions of the Kilkenny Archeological Society* for 1852 and 1854.

FRANCO (IL), of Naples, rebuilt 1596-9 the Franciscan monastery and church dedicated to the B. Vergine Assunta, also called Sta. Maria la Nuova, in that city. 95.

FRANÇOIS PREMIER (STYLE). This term properly applies to that portion of RENAISSANCE architecture seen at Chenonceaux and Chambord, with the church of S. Eustache and the hôtel de ville at Paris. It consequently dates about 1515-37; and, at best, represents the attempts made by French artists to use the materials of classic architecture without having studied the antique works. It succeeded the transitional style which, as seen in the courtyard at Blois, existed during the reign of Louis XII; and was itself superseded by the manner taught to Lescot, Gougeon, and Bullant, by the Italian masters who visited France during the last ten years of the reign of Francis I, 1515-47.

FRANKFURT on the river Main, as distinguished from the town of the same name on the river Oder, (Fr. *Frankfort*; in English *Frankfort*) is the principal of the four free, or Hanse towns, in Germany, and the seat of the German diet. It is about four miles in circuit, and is still entered by nine gates although the fortifications have been converted into boulevards. Seven of these gates belong to the city, and two to the suburb called Sachsenhausen, which is about twelve furlongs in circuit, and is united to the former by a stone bridge of fourteen arches, about 960 ft. long and 27 ft. 6 ins. wide. The Eschenheimer-thor dates 1346, the others being rather recent imitations of classic models; thus the Oberheimer-thor and the Bockerheimer-thor respectively imitate the entrance to the soldiers' quarters at Pompeii, and the temple of Nike Apteros at Athens. The central, or rather the cathedral, the Römerberg, and the Jews' portion of the town, still exhibit specimens of old domestic architecture; the best of the new houses will be found on the quays facing the river Main, in the Neue Mainzerstrasse, in the Liebfrauenstrasse or Malakofstrasse, and in the Langstrasse; with the street called the Zeil, containing shops which were formerly the mansions of the leading inhabitants. The *plätze*, about thirty in number, are of little interest except the Rossmarkt (1712) with its monument by Launitz to Guttenberg, consisting of three figures on a pedestal

20 ft. high, with four seated statues on pedestals detached from the stylobate; and the statue of Goethe by Schwanthaler.

The cathedral, dedicated 1238 to S. Bartholomew, and brought about 1350 to its present design, is built of the local fine red sandstone. It consists of an ailed nave (which seems to belong to the middle of the thirteenth century) with lateral chapels and a western porch; a choir (not ailed) with a three-sided apse (1315-38); and transepts (with eastern chapels) not only higher than the choir or the nave, but so long as to appear to be the body of the church. Its tower, commenced 1415 by Madern Gertener, was continued 1432 by Meister Leonhard, 1434 by Meister Michel, 1437 by Wiegand, 1440 by Jost, 1468 by Bartholomeo, 1470 by Jorgen, 1480-91 by Hans von Ingelheim, in whose time (1483) M. Boeblinger of Ulm was consulted, 1494 by Niclas Quecke, and 1503 till 1509 or 1512 by Jacob von Etlingen, who left the work incomplete at the height of 260 ft.; the complete design, from the parchments in the town archives, is given by MÖLLER, *Denkmäler*, pl. 59, and with some correction of drawing, under the date 1450, by KALLENBACH, *Atlas*, fol., Berlin, 1844; who also, s.d. 1350, gives the tracery in six windows of the cathedral. Of the eleven other churches, four of which belong to the Roman Catholics, there is little to be said: that of S. Leonard, 1219, shows some Romanesque work, but great part dates 1317, with alterations to rich Third Pointed German work, in fact the chancel has been rebuilt, and a nave with double aisles added, the nave and primary aisles being of equal height and vaulted, but the outer aisles being lower, and containing a subvaulted stone gallery that also runs across the west end, where it is reached by elegant stone staircases (the vaulting of the chapel at the east end of the north aisle is mentioned as worth consideration); the northern turret dates probably about 1323, and at least before 1347, the other is much older, and is supposed to have been a portion of the Köningshof: the church of S. Nicholas dates from the end of the thirteenth century and has a machicolated parapet, the openwork spire has been completed in iron; it became a warehouse 1570, was restored 1721, and again used as a warehouse from 1813 till 1841: the church of the Virgin dates early in the fourteenth century: that of S. Peter, 1417: that of S. Catherine, a groined broad edifice without aisles and with a spire 200 ft. high, 1680: the round church of S. Paul, 1786-1833, is on the site of the Franciscan monastery: the German Reformed church somewhat resembles a private mansion: the French Reformed church is rather handsome: the synagogue was rebuilt 1860-1 in a Pointed style: and there is a church, in Sachsenhausen, belonging to the establishment of the Teutonic Knights, rebuilt 1709, and now occupied as a barrack.

The other public buildings of importance are the Römer, purchased for the town-hall 1405-6, when Friedrich Königshofen built the lower halls; this edifice, or mass of buildings, was not completed as it at present stands before 1740, and was renovated 1840: the palace, formerly inhabited by the prince of Thurn and Taxis, but now the residence of the Austrian embassy, and used for the meetings of the Diet: the remains of the palace of the counts of Isenberg, near the bridge: the exchange, 1844, designed by Stüler in the style called Byzantine in Germany, with stripes of red sandstone worked into the greyish-brown stone front, it has been published by him; the *saal* itself is said to be of the 'old Indian' style: the *braunfels*, dating before 1495, and formerly used as the exchange: the modern courts of justice: the mint: the post office: the hauptwache and the constabulary: the Stadel'sches Kunst-Institut or picture gallery: the public library by Hess, finished 1825 with a hexastyle portico of a Composite order: the *saalhof*, which dates 1717 except its ancient chapel: six hospitals and several almshouses, especially the waisenhaus built by the baumeister Hübsch, from the plans of the baurath Burnitz; and the Heiligegeist or S. George's hospital: and the cemetery (1828)

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with its dead-house. Perhaps one of the oldest stone buildings in the city is the house built near the cathedral, 1454, for the Melem family, which is still called 'das Steinern-haus', given in KALLENBACH under the date 1400-10: eastward of the cathedral is an isolated building erected 1438, called the Mehlwaage, but used as a prison for debtors: a little to the south is the turreted high red building called the Fürsteneck; it is supposed that the 'Badischerhof' hotel was the gateway to it. The casino and the burger-verein club-houses are also worth mention. HEYNER, *Führer*, 1861; WEBB, *Eccles. Sketches*, 8vo., London, 1848; LERSNER, *Chronique de F.*, 1734. A plan of the city is given in the *Handbook*; and in the Maps of the Society for the Diffusion of Useful Knowledge. 28. 50. 92.

FRANKFORT or GERMAN BLACK. Two pigments are called by this name. One is an earth that inclines to blue in colour, and was known to the ancients, as appears from DIOSCORIDES, v. The other, resembling the trygon of PLINY, *H. N.*, xxxv, 25, or the black and dark blue of VITRUVIUS, vii, 10, and the *fecchia di botte* of the Italian painters, which were made from the burnt lees of wine, is nearly as intense as lamp-black and Indian-ink: it results from burning pressed grapes with lees of wine, kernels of peaches, and shavings of wood. 6. 104.

FRANKING. A term applied by the makers of window-sashes to the mode of forming the joint where the cross pieces of the sash intersect each other, no more wood being cut away than is sufficient to show a mitre. 1.

FRANKLIN (JOSEPH), born at Stroud in Gloucestershire, went about 1800 to Liverpool, where he entered the office of B. Haigh, builder, and ultimately a partner with him and his son; he retired in 1837 on being appointed architect and surveyor to the corporation on the resignation of J. Foster, which office he gave up about 1847. Amongst other buildings, he designed Great George-street chapel for Dr. Raffles, 1840-1 (Roman Corinthian), the portico with ten columns; the Crescent chapel, Everton (Ionic), 1837; and Pembroke-place chapel (Grecian Ionic), 1839; all for the Independents or Congregationalists: also the Corporation Baths in Paul-street; the mansion at Richmond hill for W. Brown, Esq., M.P.; another for J. B. Yates, Esq.; and others near Liverpool. He died at Cooper's hill, near Stroud, early in September 1855; *BUILDER Journal*, xiii, 455.

FRANQUART or FRANQUAERT (JACQUES), supposed to have been a pupil of Rubens, was born 1577 (not 1595 as stated by DESCAMPS) at Bruxelles, studied at Rome, and became architect and painter to the archduke Albert, for whom he executed a chapel in the church of SS. Michel and Gudule in his native place. In that city he also erected the church of the Jesuits, the first stone of which was laid by himself 23 June 1606, finished 1621, and destroyed 1812; designed 1629 the church of the grand Béguinage, finished 1647, at Malines; and made several additions to the château at Barbanson, where the chapel by him is still admired. He published, 1622, *The First Book of Architecture*, containing several designs for doorways, a title which suggests that it was a reproduction of Vignola's work, with the appendix of Michel Angiolo's doorways. The portrait of Franquart was engraved by C. Galle or by Hollar, or by each of them. He died 1652. 68. 97. 98. 101.

FRANQUART or FRANQUAERT (. . .), supposed to have been a relation of the artist above named, built at Bruxelles towards the end of the seventeenth century, the theatre destroyed 1817; he is supposed by LE MAYEUR to have erected (except the choir) the church of the abbey of S. Pierre at Ghent, attributed by other authors to an Italian architect, because MALINGIE, writing in 1779 about the construction 1714 of the dome, and supposing that the original plan must then have been consulted, says that it was lost in his time; and that the abbot Schayk, not content with consulting the architects who were practising a mediæval style, obtained a design from

Rome, and laid the first stone 1629; it was not finished till 1729. 68. 97. 98. 101.

FRANQUE (JEAN-BAPTISTE), born 1683 at Villeneuve-les-Avignon, is noticed by his namesake (and probably son), in the biography of Mignard in D'ARGENVILLE, *Vies*, 12mo., Paris, 1788, i, 411, as having built, besides many churches, *châteaux*, and houses in different provinces of France, several monastic establishments, hospitals, markets, especially those for fish and for meat, hôtels, and houses at Avignon, together with the great *séminaire* de S. Charles. The Benedictine abbey at Montmajour near Arles, which had been erected by Mignard, was rebuilt after the fire that occurred about 1730, upon Mignard's design, by Franque, who died 1758. He is specially praised by his biographer as being the first to make large hanging staircases which have steps carrying strings that are not more than $8\frac{1}{2}$ or $9\frac{1}{2}$ ins. thick, and that are flush (*à la règle*) on the underside. His works were also remarkable for the vaults, which are almost as flat as ceilings.

FRANQUE or FRANQUE (FRANÇOIS), probably the son of the above named, was inspector of the works 1751 under the younger de Cotte, who died 1767, at the hôtel des Invalides at Paris; succeeded to the superior post, and also to his teacher Contant (who died 1777) in the works of the royal abbey of Panthéon, commenced about 1769, in the rue de Grenelle at Paris, where Contant's drawings were carried out. A design by Franque himself, who so early as 1755 had been elected a member of the Academy of Architecture, is given in the *Encyclopédie Méthodique, Arts et Métiers*, s. v. Architecture, pl. 16-21; that work also gives, pl. 25-8, his clever plan for the hôtel de Villefranche at Avignon, and, pl. 38, his design for the staircase of the Cistercian abbey at Vauluisant (Yonne). BLONDEL, *Cours*, 8vo., Paris, 1771, iii, 143, 454, iv, 359, 360, v, 85, refers to him in high terms. The entrance of the *séminaire* executed 1740 at Bourges; the façade of a house in the rue du Coq S. Honoré at Paris; the plan of the Premonstratensian abbey built 1765 at Villars Cotterets; the plan of a design for a private house; and the iron railing to the house at Neuilly of M. Voyer d'Argenson, were his contributions to the plates of the *Cours*. The Benedictine abbey at Corbie (Somme), given in NODIER AND TAYLOR, *Voyages Pitt.* (Picardie), fol., Paris, 1835-48, i, was designed by Franque, who became architecte du roi, and who died, it is presumed, early in the Revolutionary period.

FRARY (ALEXANDRE JULES according to GABET, but ALEXANDRE JUSTE in the *Nouv. Biog. Gén.* by HOFER), born 1779 at Paris, designed the façade of the baths in the rue du Mail, and a library or gallery for the marquis de Fortia in the rue de La Rochefoucault in that city; restored the principal front and the saloons of the palais de justice at Carpentras; made some additions to the palais de justice at Orange; and designed the new theatre at Avignon, which was completed 1834. Frary was a pupil of Percier and of B. Vignon; obtained a prize for a design for a temple of Glory; and published *Monumens de Sculpture, etc., de l'ancien Comtat Venaissin*, etc., 26 pl., 4to., Paris, 1834. He died 20 March 1854. 68.

FRASCATI. The seat of a bishopric in the Comarca in Italy. The town, which received 1537 the rank of city, consists of straight streets which mostly run into piazzas, each giving a *punto di vista*, and contains some houses that date in the fourteenth and fifteenth centuries. The ailed cathedral, dedicated to S. Pietro, was designed by C. Fontana, and completed 1700: the church of the Franciscan monastery dates 1572-85; that of Sta. Maria del Vivario, or SS. Rocco e Sebastiano, is called the *duomo vecchio*, and has a low campanile in the Italian Gothic style of the fifteenth century; that of Sta. Maria delle Scuole Pie, first stone laid 3 May 1632; that of Sta. Flavia Domitilla, 1636; that of the Jesuits next the seminario, 1701; the five monasteries and a nunnery; and the palazzo vescovile, formerly a fortified mansion called *la Rocca*, built about 1480 and restored 1701, are the chief

public buildings. Besides the Camaldolese monastery designed by Alessandro Cecchi of Venice (first stone laid 29 May 1607), with a church erected 1611 by Tarquini, but rebuilt 1772, are the palaces which, under the modest name of villas, have been for centuries the favourite residences of the most wealthy of the modern Romans. As the names of their owners at the time when drawings were made are frequently the only indications attached to illustrations of them, the following list of the successive titles will be found useful: and although only eleven are named, it is stated that so many are not to be found in the vicinity of any other city or town near Rome. Villa Acquaviva (1591), afterwards Peretti di Montalto, Borghese or Savelli, and Odescalchi duca di Bracciano, now collegio di Propaganda Fide. Villa Arrigone, afterwards Rocci, and Varesi, since divided between the Cesarini, Muti, and Amadei families. Belpoggio or villa Strozzi, afterwards Ceri, Borromei, and Visconti, now Pallavicini. Belvedere or villa Aldobrandini (1603), Pamphili (1680), and Borghese (1796), now Borghesi-Aldobrandini; the last work of G. della Porta, whose buildings were finished by G. Fontana, who designed the waterworks which were executed by Olivieri of Tivoli. Villa Bonani, afterwards Mattei, Gonzaga, Primi (1617), and Piccolomini, now divided and the larger portion alienated. Villa Ludovisi (1621-3), afterwards Conti, Sforza Cesarini, and Torlonia (1826). Villa Mondragone (1572-85), built for cardinal Marco Sittico Altemps, is no wno longer a villa but merely a deserted palazzo Borghese, as it was sold to pope Paul V (1605-21), who employed G. Vansanzio to enlarge it, and F. Ponzio for the entrance; the gardens were designed by C. Rainaldi, but the great loggia in them is attributed to Vignola; and the fountains were added by G. Fontana. Villa Rufina (1548-78 attributed to Vignola), afterwards Falconieri, when Borromini built the palazzo. Villa Rufina or Rufinella, afterwards Sforza-Deti (1587), Sacchetti (1639), bought 1740 by the Jesuits, for whom it was enlarged (1742) by Vanvitelli, became 1773 papal property, has belonged since 1804 to Lucien Bonaparte, and later to the king of Sardinia. Villa Sora (1572-85), afterwards Buoncompagni. Villa Taverna (about 1604-15), afterwards Peretti (1614), and Borghesi, now called the villa Borghesiana; it was enlarged by G. Rainaldi. These rank in the following order: Aldobrandini, Mondragone, Rufinella, and Taverna.

The only antiquities, besides a large circular tomb, near the town, are the remains of TUSCULUM, which was destroyed 1191. About two miles from Frascati may be seen the vestiges of cisterns, villas, and walls; with a theatre that is very perfect, most of the seats, the orchestra, and the scene being entire; an amphitheatre of late (reticulated) work, 225 ft. long by 166½ ft. wide; a gate; a fountain; and a subterranean reservoir that is covered by a false (horizontally coursed) vault, and entered by a conduit 5½ ft. high by 2 ft. wide. The material, in all these works, is the local *sperone*, or lapis Tusculanus, a volcanic conglomerate of yellow cinders hardened or baked by the lava which has risen under it. 28. 50. 96.

FRATER-HOUSE or FRATERY, see REFECTORY.

FRAXINUS, the Ash. A fine forest tree, a native of the cooler parts of Europe, from Great Britain to the north of Asia; and of some parts of North America and Canada. It grows from eighty to one hundred feet in height. In its appearance it is singularly graceful, and when mingled with ruins of buildings, as at Netley abbey, near Southampton, they have a beautiful effect.

F. excelsior, the common Ash, produces timber not so durable as the heart wood of the oak, but surpassing it and all other British timber in toughness and elasticity; it is thus of essential use to the wheelwright and other like trades. The timber is too flexible and not sufficiently durable for building purposes: it soon rots when exposed to either damp or alternate dryness and moisture, but is tolerably durable in a dry situation. Thus it is said to have been formerly much used in staircases, as at Wroxton abbey; and for kitchen tables, on account of its admitting of being well and readily scoured, and of not splintering. The roots and knotty

parts of the trunk are used by cabinet-makers, the curious dark figures formed by the veins having a remarkable appearance when polished; *EVELYN* says the ash was prized equally with ebony, and was called green ebony.

The colour of the young wood is brownish white with a shade of green; that of the old is oak-brown, with a more veined appearance. The texture is alternately compact and porous; where the growth has been vigorous, the former bears a greater proportion to the latter. The "useful applications" of the ash forms an article in the *PENNY MAGAZINE*, 1843, xii, 470. *HOLTZAPFEL*, *Woods*, 1843; *TREDGOLD*, *Carpentry*.

F. Americana, White Ash (Fr. *Frêne blanc*), a native of Canada and of the northern part of the United States, is a large tree, growing to a height of 80 ft. and 3 ft. in diameter, producing planks 20 ins. wide. The wood is strong and durable; splits straight; is not apt to shrink; and is of a red colour with a white sap.

F. sambucifolia, Black Ash (Fr. *Frêne noir*) or Water Ash, of the same locality, will provide planks 28 ins. wide. The wood has a very pretty appearance suitable for wainscoting. *F. tomentosa*, Red Ash; *F. viridis*, Green Ash; are similar in quality: whilst *F. quadrangulata*, Blue Ash, from the inland parts of the United States, about 18 to 20 ins. in diameter, provides boards for flooring, external coverings, and sometimes shingles. *MICHAUX*, *N. Amer. Sylva*, &c., Phil., 1817, iii, 233-247.

A wood called African Ash, resembling American maple, was used in the furniture at Balmoral, 1855.

Mountain Ash, or Rowan tree, see *PRUNUS*.

Specimens of ash have been sent from Hungary with a zigzag grain, and considered to be very handsome for furniture.

To whiten old ash wood furniture, it may be cleaned with sulphuric acid.

FREDERICTON, formerly called *S. ANN*. The capital of the British province of New Brunswick in North America. The streets are laid out upon a regular plan, some being a mile in length, which are for the most part continuously lined with wooden houses. The province-hall, the government-house, and some ecclesiastical buildings, less deserve notice than the cathedral. Fredericton became the seat of a bishopric in 1845; and on the 15 October the first stone of the cathedral was laid by its designer, Francis Wills of Exeter, who left England for the purpose of superintending the construction. His design is described in the *ECCELSIOLOGIST Journal*, 1846, v, 81; but it was changed, and the revised design, of which a view is given in the *ILLUSTRATED LONDON NEWS*, 1849, p. 276, was again altered, as noticed p. 370. In 1846 difficulties of foundation were discovered, but the works were resumed 1847; the walls, built of a hard-grained sandstone quarried at about a mile from the work, were raised so as to allow the stained pine roof to be finished 1848. The weatherings are of a hardish freestone from the Bay of Fundy; and the masonry of the windows and interior work is of Caen stone wrought at Exeter. The nave and aisles are described as 82 ft. long by 67 ft. wide, and 60 ft. high to the ridge; the choir 70 ft. long; with a central tower 27 ft. square and 84 ft. high, carrying a wooden spire protected by galvanized iron, rising to a total height of 170 ft. This tower was a substitute for two that were intended to have been 180 ft. high, and to have formed transepts 100 ft. long. The style is Middle Pointed. The *ECCELSIOLOGIST Journal*, 1852, xiii, 295, 352, notices that the exterior was complete, that the fittings were ready for the interior, and that the work had been finished under the advice of W. Butterfield of London.

FREDERIKS (*CORNELIS*), a Frisian architect, succeeded Jacob van Aaken in the erection of the Oldenhoover tower at Leeuwarden (commenced 1529); and, considering the foundation at one of the sides not to be strong enough for the completion of the original design, only carried up the tower to the height at which it now stands, and covered it with a terrace roof of lead, surrounded by an iron railing. 24.

FREDERIKSTADT DEALS see *DEAL*.

FREDIANI (...) is noticed by *MILIZIA*, *Lives*, s. v. Teodoli, as being reputed by some writers to be the designer of the teatro Argentina at Rome; no dates are given.

FREE CHAPEL. A place for divine worship which, having been founded by the sovereign, is exempt from all jurisdiction of the ordinary (save only that the incumbent is

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generally instituted by the bishop, and inducted by the arch-deacon of the place), and only to be visited by the founder and his successors, which is done by the lord chancellor: yet the sovereign may licence a subject to build and endow a chapel, and by letters patent exempt it from the visitation of the ordinary; but if the patron of a secular or free chapel be made in the words *ad ecclesiam* instead of *ad capellam*, and his clerk be instituted and inducted thereto, etc., it loses the name of a free chapel; *AYLIFFE*, *Parergon*, fol., Oxford, n. d. p. 165-6. There has been some confusion between free chapels and colleges, because in some of these chapels were colleges of prebendaries, as in the cases of those at the castles of Holyhead and Tickhill. A list of free chapels is given in *DUGDALE*, *Monasticon*, which notices that the bishop of Exeter is patron and visitor of the free chapel at Bosham in Sussex. *PHILLIMORE*'S *BURN*, *Eccles. Law*, 8vo., London, 1842, p. 529, notices that most of these chapels were built upon the manors and ancient demesnes of the crown, whilst in the king's hands, for the use of himself and retinue when he came to reside there. And when the crown parted with those estates the chapels went along with them, and retained their first freedom; but some lords having had free chapels in manors that do not appear to have been ancient demesnes of the crown, such are thought to have been built and privileged by grants from the crown.

FREE-HAND DRAWING. A term employed for drawing by the hand, in contradistinction to drawing with a ruler, etc.

FREEMASON (Fr. *maçon*; *tailleur de pierre*). A designation formerly in use in the building trade for a stone cutter, and now merged into the general term, mason. The earliest use of this word at present known is in a record of 1396, for works at Maidstone, as "*Lathomos vocatos fire maceons—Lathomos vocatos ligiers*", *RYMER*, *Fœdera*, Syn. xvii. The Fabric Rolls of Exeter cathedral, dating 1396-7, are said to contain the word 'freemason'; *FOUNDYNG*. *MASON*.

The word *LATHOMOS*, derived from the Greek, is seen in an inscription, dating 1257, on the cathedral of Notre Dame at Paris (*INKERSLEY*, *Inquiry*, 8vo., London, 1850); but it is not found in England until the end of that century, nor until the middle of the following century, in general use. The term previously employed was the Latin word 'cementarius', as in the London Assize of 1212 (*Brit. Mus.*, *Add. MS.*, 14,252, fo. 133 b, and in *TURNER*, *Dom. Arch.*, 8vo., London, 1851), which has likewise the title 'sculptores lapidum liberorum'. As exhibiting the connection of 'freemason' with 'freestone', and its probable derivation therefrom (although some writers assert its origin from 'free' of the company of masons), the following may be stated; an indenture of 1314 in the French language, is to the effect of a 'masoune' having to erect a house 'de pere franche'; *PARKER*, *Dom. Arch.*, 1853, ii, 5; *FREE-STONE*; and though the statute of 1349 uses the word 'cementarius', that of 1350-1 contains the words 'mestre mason de franche peer'; that of 1360-1 has 'de franche pere ou de grosse pere', wherein the workman is called 'maceon'; and that of 1444-5 mentions a 'frank mason', and 'un rough mason'. Thus four classes are probably obtained, viz., the freestone mason (Fr. *l'appareilleur*); the rough or rubble waller (Fr. *le limousin*); the layer or setter (Fr. *le poseur*); and the common workman (Fr. *le débardeur*). The above derivation of freemason would be supported also by the fact that the term freemason was not adopted in Scotland, where the stones in general do not enter into the class of freestones as in England.

A fraternity or guild of masons existed in the city of London in 1375, 49th Edward III; and in the following year, another of freemasons is noticed. The latter body is said to have merged into the former; this certainly took place before 1421, and probably about 1411, the date recorded in the usual subscription to the coat of arms of the company of masons, as the period of its charter of incorporation. *HALLIWELL*, in *Archæo-*

logia, 1838-9, xxiii, 447-9, states that a company of 'under-masons' was formed in London in 1473, 12 Edward IV. The guild is called 'cementarii' in 1422 and 1423. Others existed in the corporate towns. The statute of 34 Edward III, 1360-1, declares "that all alliances and covines of masons and carpenters, and congregations, chapters, ordinances, and oaths betwixt them made or to be made, shall be from henceforth void and wholly annulled", etc.—an act enforced by many of later date, especially by the often quoted one of 3 Henry VI, 1425; and even as late as 1548 the confederacies continued illegal. The general statute of 5 Elizabeth, 1562-3, further restricting workmen, continued until 1813, when that portion which empowered justices to rate the wages of artificers and labourers was repealed; and in 1814 a further portion was repealed, as forbade exercise of trades by persons not having served an apprenticeship, and as regulated the mode of binding, etc., at the same time the customs and privileges of cities and boroughs were saved. Statutes to a similar effect as those above mentioned were passed in Scotland, which country had guilds corresponding to those of England.

The masons' guilds or companies, like those of other trades, had a legendary history of the origin of their trade; this, together with the supposed 'constitutions' or bye-laws, have been printed many times; a good specimen is given in the *GENTLEMAN'S MAGAZINE* for 1815, pt. i, 489. One in manuscript, on parchment, dating the latter part of the fourteenth century, exists in the British Museum, Bib. Reg., 17, A. 1, ff 32, and is peculiarly interesting from being written as a poem of 575 lines, the versifier being probably a priest. This MS. was first noticed by HALLIWELL in the *ARCHÆOLOGIA*, xxiii; and edited by him as *Constitutions of Masonry*, 8vo., London, 1840; 2nd ed., 1844. Another manuscript of the latter part of the fifteenth century, bought for the same library in 1859, Addit. MS. 23,198, has been edited as a facsimile by COOKE, *History and Articles of Masonry*, 12mo., Lond., 1861. These, with the later manuscripts and texts, are all in English. It is noticeable that no two copies are alike, while none afford any clue as to the date of compilation.

As regards the interesting question of a supreme guild directing the systematic working of these corporations, nothing has yet been discovered in England; for the text of the above legends, etc. may be applied for and against such a decision. In respect of Germany, however, GRANDIDIER, *Essai sur le Cath. de Strasbourg*, 8vo., Stras., 1782, shows that, besides other companies of masons, the masters of the lodges (*hütten*) of masons employed in the erection of buildings and cutting of stone, in several cities of Germany, assembled at Ratisbon, so late as 1459, when they drew up an act of fraternity, which established the chief mason of the cathedral of Strasbourg (then Jost DOTZINGER) and his successors, as sole and perpetual grand-master, a predominance which lasted until 1707. This society, he states, received the sanction of the emperors (probably in a similar manner to the charters granted to the English guilds); and to distinguish themselves, the members adopted words, tokens, and signs, and instituted certain ceremonies on the reception of new members. Although its jurisdiction was early sanctioned in matters relating to building, and the archives of Strasbourg are full of such documents (*hütten-briefe*), the magistrates withdrew the privilege in consequence of the bad use made of it. It is to this lodge at Strasbourg (the cathedral was begun in 1277, by Erwin von Steinbach) that STRIEGLITZ, *Geschichte der Baukunst*, 8vo., Nur., 1827, p. 428, observes that pope Nicolas III gave, in 1278, a letter of indulgence, renewed by his successors, and by Benedict XII in the fourteenth century. HEIDELOFF, *Die Bauhütte*, 4to., Nur., 1844, also contains some documents apparent to a purport similar to the English constitutions. LODGE.

But little appears to be known of a building fraternity in France. Ordinances of the carpenters and masons are, however, still preserved in the *Registres des Métiers et Merchan-*

dises, at Paris, printed in the *Règlements sur les Arts et Métiers de Paris, rédigés au xiii^e siècle*, edited by DEPPING, 4to., Paris, 1837, which exhibit rules and regulations. In Italy still less is known of the customs of this trade. COMACENUS.

The monopoly exercised by fraternities of all trades in the chartered towns of England becoming abridged or intruded upon, as well by the increase of new towns as by the settlement in this country of large numbers of foreign artists and workmen in other towns, a system was adopted of accepting members not exercising trades, to the benefit of the privileges of the chartered companies. This commenced early in the seventeenth century, if not before; the traditional history and forms being kept up, those of the masons more especially spreading (from political causes probably), may account for the retention in scattered localities of 'Lodges of Freemasons,' it being alleged, moreover, that from traditional usage, any five, or even one, mason could make a brother mason. Four, at least, of such lodges existed in London in 1717, when a meeting was held and a grand lodge constituted, from which, in England, has resulted the present 'Society of Free and Accepted Masons.' A similar grand lodge was formed for Ireland in 1730; for Scotland in 1736; and the lodges extended throughout the world. What is now understood by 'practical and speculative freemasonry' will be best known from the many publications issued by the members of that respected fraternity; these works, however, put forward a large claim to an antiquity that is not sufficiently supported by historical evidence.

As regards this nation, comparatively so few Fabrick Rolls and other documents relating to buildings have been printed, that but few of the actual designers, as the master masons most probably were, of the edifices are known. In this work it has been attempted to arrange those recovered, under the cities, and under their names, in all countries. For England, also, it has been attempted by W. PAPWORTH, *The Superintendents of Buildings*, etc., given in the *Transactions of the Royal Institute of British Architects*, 1859-60 and 1861-2; previous to which, DALLAWAY, *Collections for an Historical Account of Master and Free Masons*, 8vo., Lond., 1833, had treated the subject in a professional view. Otherwise, nearly all other writers have felt the influence of the publications relating to the Friendly Society above mentioned: such as, ANDERSON, *The New Book of Constitutions of the Ancient and Honorable Fraternity*, etc., 4to., Lond., 1723, and its enlarged editions by NORTHOUCK, by PRESTON, and by OLIVER, for England; of LAURIE, *The History of Freemasonry*, etc., 8vo., Edinburgh, 1804, and 2nd ed., 1859, for Scotland; and by SPRAT, *The New Book of the Constitutions*, etc., 8vo., Dublin, 1751, for Ireland. KRAUSE, *Die Drei ältesten Kunsturkunden der freimaurer bruderschaft*, etc., 2nd ed., 8vo., Dresden, 1821, is a collection of works relating to this society. W. P.

FREE SEAT. A phrase sometimes used to designate seats in a church, which are at the disposal of the churchwardens, in contradistinction to those pews for which a faculty had been granted and were therefore private property: it is said the faculty pew may be kept locked. In later times it signified seats that were not appropriated to any parishioner, but were left for the benefit of strangers. At present the Incorporated Society designate as free seats those which, being wholly in the control of the churchwardens, are to be by them allotted or appropriated to the use of the different parishioners, which allotment is subject to revision once in every year, though practically they are left open for allocation by any person attending the service, provided the allottee does not attend by a certain time. The dimensions required by the society are 20 ins. for each person, 2 ft. 6 ins. in the clear width from back to back, and 2 ft. 8 ins. in height for the framing. A. A.

FRESING, see FRIEZING.

FREESTONE (Fr. *pierre de taille*). A name applied technically to all stones which are able to be worked freely by the mallet and chisel, in contradistinction to the stones which

are worked by the pick, or by the hammer. Yorkshire dolomites, Portland and Bath limestones, a great variety of gritstones, and the various marbles, are examples of freestone; the granites, basalts, lavas, and trap rocks, are examples of the stones it is necessary to strike away, or to stum—of those, in fact, which do not work freely. ASHLAR: FACE WORK: FRANCA PETRA: MASONRY: SANDSTONE. G. R. B.

This term is also applied locally, as at Bristol, to oolite or Bath stone, in contradistinction to Stapleton stone, which is harder; and in Yorkshire, to gritstone and not to limestone, though the gritstone is as hard as that of Stapleton.

The earliest use of this word appears in the Close Roll of 43 Henry III, 1259—'Figures of kings cut in freestone', as translated by TURNER, *Dom. Arch.*, 8vo., Oxford, 1851, 263; who also states, p. xxv, that 'the freestone of Maidenestane or Maidstone occurs in a record of the thirteenth century, relative to a private building in London'. DEVON, *Issues*, etc., 4to., London, 1837, 44-47, notices, amongst other uses under the above date of 1259, 'five quarters of freestone from Chelvedon—for the chimney', costing 6s. per cwt.; 'One ship load of grey stone for the gutters'; 'Freestone cut from ashler'; and in *Brantingham Roll*, 4to., Lond., 1835, xxxiii, 3 Edward I, 1275, is 'for grey freestone'. The mention of 'pere franche' in 1314, is given s. v. FREEMASON. W. P.

FREE STUFF. This term, properly free *working* stuff, is applied to wood which has a soft and smooth texture, working easily and cleanly under the saw, plane, etc., in contradistinction to the coarser sorts of yellow deal, which require greater labour; and to spruce, the grain of which is apt to tear up in planing. Pine plank and the milder qualities of yellow deal (as Archangel) used for panels, moldings, etc., are generally free stuff. A. A.

FREEZE, see FRIEZE.

FREEZING, see ATMOSPHERIC INFLUENCE; BRAUD'S DISINTEGRATING PROCESS; CONGELATION; and EXPANSION.

FREIBERG (in late Latin *Friburga*). A city, upon the river Münzebach, in the circle of Dresden in Saxony. It consists of an inner town, entered by five gates, and still partly surrounded by old walls flanked with numerous towers, and four suburbs. The streets, which are wide and paved with gneiss, also used for building, contain some old houses, each having an archway with a niche and seat on either side. The 'golden gate' is a Romanesque portal, dating about 1175-89, which belonged to the church dedicated to the Virgin, destroyed by fire 1484: the new cathedral, under the same invocation, was built 1484-1500, without towers, in a Pointed style, resembling the type established at Zwickau 1453-1536; the lady chapel dates 1593. The whole was renewed 1826; the chapel was enriched with local marbles, and with twenty-four sepulchral brasses laid in the pavement. The church of S. Peter's, with three towers, one of which is very lofty; that of S. Nicolas, with two towers; three other churches; the rath-haus, 1410; the mining academy; the silver refinery; three hospitals; and the theatre, almost complete the list of public buildings. PUTTRICH, *Denkmäler*, fol., Leip., 1836-52, i, 1. 28. 50. 92.

FREIBURG (or FREYBURG) IM BREISGAU (in late Latin *Friburgum-Brigovium*; Fr. *Fribourg en Brisgau*). A city on the river Treisam, in the circle of the Upper Rhine, belonging to Baden. The town, which is entered by four gates, one of them a tower built in the thirteenth century, has two suburbs, and as many large squares or market-places; the streets are narrow and winding; the houses, substantially built, are well supplied with water; two fountains are in a Pointed style. The *münster*, or archbishop's cathedral, said to have been commenced 1152, has a nave and central western tower and lantern, of the very best style of Gothic in the middle or close of the thirteenth century (sometimes called 1236-72), and decidedly French in character and treatment, according to PICTON, *Architectural Notes*, in the *BUILDER Journal*, 1857,

xv, 241, who notices the transepts as late twelfth-century work, some of their arches being slightly pointed; and the choir and its aisles as Flamboyant of very late date (some writers state 1513), the choir screen being Renaissance in character, with a Flamboyant balustrade. The same author, describing the rich and lofty open porch of the western or great tower, speaks of the superstructure as having much beauty peculiar to itself, though it resembles Strasbourg in general design; while German critics follow KUGLER in considering it as the acme of German Pointed art: and he mentions as salient features, the slender Romanesque towers at the reentering angles of the choir and transepts, the upper part having been modified to a later style; the absence of a triforium in the nave, its place being supplied by a passage gained by a set-off in the wall over the pier-arches, and fenced by an open traceried balustrade rising above the cill of the clearstory windows; an arcade under the windows of the side aisles; the octagonal cupola on pendentives at the intersection of the nave and transepts, which has been modernized; the complicated vaulting (fifteenth century) of the choir and its aisles; the retables to the several altars; the stone pulpit, very good sixteenth century work; and the old stained glass. The vaulting of the floor below the spire deserves study. This edifice, which is built of a light-red sandstone, and has the choir, vault, and roof slightly higher than those of the nave, is described by ENGELBERGER, *Beschreibung*, 1847, and well illustrated in MÖLLER, *Denkmäler*, fol., Darms., 1821; also in GAILHABAUD, *Mons*, iii, 34; and in SCHREIBER, *Münster*, fol., Freib., 1826, whose edition of the contract, 1471, with Hans Niesenberger, master mason, is translated in the *BUILDER Journal*, 1850, viii, 183. Peter von Basel and Heinrich der Leittr, 1332, and Johann von Gmünd, 1359, had preceded him, and to them may perhaps be ascribed the completion of the tower with its four angle turrets, and the octagonal lantern with the spire, stated to be 372½ Rhenish, equal to 381 or 383½ English, ft. high. The choir, said to have been designed by Albertus Magnus, bishop of Ratisbon (died 1282), was perhaps laid out 1354, but the erection was delayed until the arrival of Niesenberger of Gratz, who superintended the work till 1513; he was succeeded by Hermann Neuhäuser, who died 1524, and the names occur of Leonhard Müller till 1533, and of Hans Metzinger, with Wolf Roch, till 1554. The porch at the south transept is neo-classical.

The Protestant church, which was transferred 1829 stone by stone, from the abbey of Thennenbach, about fifteen miles off, may claim to be of the same period, at least, as the nave of the cathedral; the church of S. Martin, formerly belonging to the Franciscans; next to which is a monastery with a fine hall in a Pointed style, are of interest. The church of S. Ludwig, with a square tower, is a modern Byzantine design. The other important buildings, passing over the monasteries, hospitals, and educational establishments including the university, except the Roman Catholic seminary, are the grand-ducal palace and government buildings, the new barracks, the theatre, the corn market, and the building, variously mentioned as the town-hall, the merchant house, the tax office, and the custom-house, facing the south side of the cathedral, which appears to have been erected in the sixteenth century, and has an intricately vaulted arcade on the ground floor, above which is a rich front with turrets corbelled from the angles.

FREIBURG upon the river Unstrut in Saxony, is sometimes confounded with the above city. It possesses a Romanesque church with three towers, wherein the restoration of the nave with the rebuilding of the choir was being executed about 1500 by Peter von Weissenfels; and a two-storied chapel in the castle: both are described by LEPSIUS, *Illustrations*, 4to., 1839; and illustrated by PUTTRICH, *Denkmäler*, fol., Leip., 1836-52, 2, i, pl. 2-10. 28. 50. 92.

FREIBURG in Switzerland, see FRIBOURG.

FREIBURG (CRISTOFANO DI) was employed at the cathedral of Orvieto under and after Pietro di Giovanni di Freiburg,

who may be supposed to have been a son of Johann von Gmünd. DELLA VALLE, *Storia della Duomo*, 4to., Rome, 1791, pp. 120, 122, 291, 382.

FREISING, sometimes written Freisingen, Freisinghen, Freysing, Freysingen, or Frisinghen. The capital of the district of the same name in Upper Bavaria; it was the seat of a bishopric until 1817, when the see was added to that of Munich, which was made archiepiscopal. The cathedral, dedicated to the Virgin, stands on an eminence, and has a rich Romanesque porch between two gabled towers at the west end; from the upper story of that front there is a bridge connecting the building with a detached chapel, of Third Pointed work, with aisles and clearstory, and tolerable tracery. The Romanesque crypt (1159-1205) of the cathedral has the unusual plan of four aisles with a large semicircular apse at the termination to the two central ones. The nave, lower than the choir, and having double aisles forming chapels which are separated from the church by grilles and a gallery all along it, is highly coloured, and exhibits Renaissance details with much work in marble. Thirteen high steps lead to the choir, and (SIGHART, *Dom.*, 1852) seven more to the altar: the bishop's seat is placed on the north side of the church: WEBB, *Sketches*, 8vo., London, 1848, p. 129. The episcopal palace, a small castle seated on a hill, the town-hall, four churches, a seminary, an hospital, and two asylums, are of less importance architecturally than the wooden bridge of two arches, each 153 ft. in span and 25 ft. wide, with a rise of 11 ft. 6 ins., rebuilt after its destruction in the campaign of 1809, on nearly the same method as when first constructed in 1807-8, i. e. of curved planks: it is illustrated in BARLOW'S TREDGOLD, *Carpentry*, 4to., London, 1853, p. 142, pl. 17. 28. 50. 96.

FREISINGEN, see FREISINGEN (ULRICH VON).

FREIZING. A term, apparently meaning pointing or else rough-casting, which occurs with respect to the church of S. Nicolas at Great Yarmouth, Norfolk, in the following minute—"1713. The churchwardens acquainting this assembly that the south side of the church is in want of freizing, the vestry are desired to direct the churchwardens to frieze the same if they shall think fit". It is evidently the same word as 'freising' which HOLME, *Academy*, fol., Chester, 1688, iii, 259, speaking of the embossed parts of work as being either hatched or freed, says, "is to fill up all void places with scrolls, turns, or leaves, or making them full of pricks or holes"; and it has been suggested that the word is a corruption of friezing, derived through the Italian *fregio* from the Latin *phrygio*, an embroiderer. At the present time the word appears to be sometimes used in Hertfordshire, for roughening the surface of the first coat of plastering, which is done by sweeping a rendering or laying coat with a broom, or by scoring the pricking-up coat with the end of a lath called a scratcher, and the trowel is sometimes used.

FREJUS (the Roman Forum Julii). A city in the department of the Var in France. Almost the only edifices that deserve notice are the remains of the ancient constructions, which comprise vestiges of the walls and quays, with a light-house from which the sea has retired about three or four miles; the remains of three gates to the town, one being partly closed; another in what was the garden of the monastery of the Cordeliers; and the third, *la porte dorée*, so called from the gilt heads of the large nails that held the mooring rings; an amphitheatre, recently cleared out, which was one of the smallest of its class, being only about 300 ft. in circumference, and is not in such good preservation as those at Nîmes and Arles; and an aqueduct about forty-five miles in length, which began at the village of Mons, about twenty-one miles from Fréjus: these last three subjects are illustrated by LABORDE, *Monumens*, fol., Paris, 1816, pl. 13, 14, 31. The cathedral, dedicated to the Virgin and S. Etienne, is said to stand on the foundations of a pagan temple: the body of the church belongs to the eleventh century, but the tower and spire to the *style ogival primitif*,

according to BOURASSÉ, *Cathédrales*, 8vo., Tours, 1846. The adjoining baptistery is supported upon eight antique columns of grey granite with marble capitals. There is also an episcopal palace, a large *séminaire* built about 1766, and the remains of three monasteries and two nunneries. The quarry from which the Romans obtained the ESTEREL granite is now about twelve furlongs from the shore. 28. 50. 96.

FRENCH (THOMAS). "On the buttress of a ruinous isle in the cathedral of Old Aberdeen an inscription informs us of the architect;—Thomas, the son of Thomas French, master mason, who built the bridge of Dee and this isle, is entered at the foot hereof who died Anno 1530"; PENNANT, *Tours*, 4to., Lond., 1790, i, 141.

FRENCH ARCHITECTURE. The architecture of France is susceptible of being classed in three grand divisions, namely, Gallo-Roman, Pointed, and Renaissance. The first is distinguished by the use of the round arch, and by a close adherence to antique forms, sometimes, indeed, to such an extent as to appear to belong to the debased periods of classic art. It is found in its greatest purity along the banks of the Rhône and Saône, and in the provinces bordering on the Mediterranean, in the valley of the Garonne, and at Poitiers, at Périgueux, and in Auvergne. There is a round arch architecture northward of the Loire, which more nearly resembles the Norman of England, and is undoubtedly derived from the Rhenish Byzantine. The second grand division, viz., the Pointed, which is wholly of a northern origin, is found in its greatest purity in the Ile de France, in Normandy and the Cotentin, between the Seine and the Loire, and in the northern and western parts of Burgundy: its later development, or the Flamboyant, being found in the part of Normandy north of the Seine, and in Picardy, Champagne, Lorraine, and Brittany. The third, or Renaissance, derived wholly from Italian sources, is found in its greatest magnificence along the banks of the Loire, and is general in the châteaux, the later churches, and the large towns. H. B. G.

In the Gallo-Roman period the architecture was purely Roman; in the Carolingian period, it became a reflex of the style which prevailed about Aix la Chapelle and the Lower Rhine; in the Capetian period it gradually passed into a modification of the architecture of North-Western Germany, the true seat of the *Architettura Tedesca*, subsequently called Gothic; in the period of the Valois it passed through a modification of the Burgundian Flemish into the Renaissance of Northern Italy; in the period of the Bourbons, it was mainly founded on an imitation of the architecture of Greece and of Rome; whilst subsequently to the Revolution of 1789 French architecture has, in turn, endeavoured to assimilate to itself the Egyptian, Roman, and Florentine styles, and has finally subsided into a modification of its own early Renaissance. The various stages of this history are full of lessons of grave philosophical import; for the general tendencies, thus broadly sketched, have been exposed to many local modifications, depending upon social organization, upon the nature of the materials employed, upon the mental constitution of the various tribes which have entered into the great unity of France, and even at times on the fiscal regulations of the day. It may even be said that every great hydrographical basin of France had its own peculiar style; nor can this be a matter of surprise, for in the times when roads did not exist, the rivers were the only means of intercommunication; and thus it is found that the contemporaneous buildings of the basins of the Somme and of the Oise differed from those of the valley of the Seine, and still more so from those of the valleys of the Loire, Garonne, and Rhône; whilst the architecture of the eastern provinces of France, again, had its distinctive character. In fact, the mediæval architecture of France might advantageously be regarded under the separate subdivisions of the Upper Norman; the Lower Norman; the French Proper; the Flemish; the Angevin and Breton; the Gascon;

the Burgundo-Lyonnais; and the Provençal; all of which possess distinctly marked characteristics. G. R. B.

The periods of French architecture were formerly divided by DE CAUMONT, *Cours d'Antiq. Mon.*, 8vo., Paris, 1830-43, into Romanesque, 996; Transition, 1050; Primordial Gothic, 1150; Secondary Gothic, 1250; and its development, 1300; Tertiary Gothic, 1400; and its development, 1460. But in the *Abécédaire*, 8vo., Paris, 1850, (he acknowledging, or rather indicating, the existence of some of the schools or local influences which will presently be named), his chronology is *Architecture romane, primordiale*, from the fifth century; *secondaire*, commencing 1000; *tertiaire* or transitional, 1100; *Architecture ogivale, primitive*, 1200; *secondaire*, 1300; and *tertiaire*, 1400 till 1550: but he notices that the seventeenth century would furnish numerous examples of the use of the pointed arch; and he divides the *style de la Renaissance* into two epochs—1550-1610, and 1610-1643 or 1658.

The local characters of the mediæval architecture of France furnish the following points for a learned dissertation by VIOLETTÉ LE DUC, *Dict.*, i, 134-157, who, noting the vitality of Romanesque art in the valleys of the Rhône and the Saône, declares that it was mixed till the beginning of the thirteenth century with *contemporaneous* Eastern elements of construction and decoration—an infusion which in Burgundy and Champagne was neutralized by the *traditional* orientalism spreading from the Rhenish provinces, and that the art practised on the shores of the Adriatic had influence in Aquitaine from 984 into the thirteenth century. He notices that while construction was orientalized in the Périgord and the Angoumois, decoration alone took that impress in Normandy, Maine, Anjou, Saintonge, Poitou, and the West of France, in fact, in every part where Roman remains did not exist; and that Normandy, the North of France, and the Rhenish provinces, had plenty of men to carve combinations of orientally derived ornaments, but had no sculptors. He observes that the Ile-de-France, which had kept its Gallo-Roman traditions tolerably pure, began about 1100 to form a national style that in its developments was received in Champagne, Burgundy, and the Bourbonnais, and, in a singular instance, so far south as Carcassonne, yet did not materially influence Bretagne, Guyenne, and Provence. The Ile-de-France, Champagne, Picardy, Burgundy, Maine with Anjou, and Normandy, are the schools which he acknowledges after 1220 in the order of their period of development into Pointed architecture. Noting that they did not fuse into a common style until the end of the thirteenth century, while the artists of Auvergne and Provence passed almost at once from debased Romanesque to the Renaissance, this author fixes the commencement of the decay of mediæval art in France at 1260, and concludes by giving his objections to the rationalism of the fourteenth, and to the naturalism and verticality of the fifteenth, centuries.

The following list gives the terms under which the distinctive periods will be noticed in this Dictionary—Merovingian, commencing about 480; Carolingian, 751; Romanesque or Capetian, 987; Transitional, 1100, but in the south and on the Rhine till 1300; Early French Pointed, *Gothique à lancettes*, dated 1163-1266 by INKERSLEY, *Romanesque and Pointed Architecture*, 8vo., Lond., 1850, but past its transitional period at least before 1250; Decorated French Pointed, *Gothique rayonnant*, existing from 1241 until at least 1450, but not extinct in some districts so late as 1493, while the tower of S. Jacques la Boucherie at Paris, 1508-22, is considered as a very beautiful example; Flamboyant, *Gothique flamboyant*, which is generally dated about 1400-1515, but difficult to find before 1430, and occurring in some places till 1530, and even carried by INKERSLEY so late as 1531-74; and Renaissance, which, dating at least from the introduction 1495 of a colony of Italian artists, was for a long time in a state of transition, that has given rise to the terms '*style Louis XII*' and '*style François I*'. With the reign of Henri II the change to Italian art was completed;

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but it should be noticed that French writers sometimes carry the use of the words '*style de la Renaissance*' to the most modern period that exhibits the application of the neo-classic orders with columns that do not exceed the height of a single palatial story; thus, the great colonnade of the Louvre is held by them to belong to Roman (i. e., classic), rather than to Italian, architecture.

Noticing that the buildings, in which Pointed art exclusively appears, are chiefly situated north of the Loire, VAUPOYER suggests that after 1483, Italy became to France what Greece had been to Rome, but that the *bizarre* work of Borromini and the *baroque* of Guarini had no place upon French soil; and admits that the finest period of the Renaissance had passed away in Italy before France had adopted the new fashion. If François I employed Vignola and Serlio as well as Gougeon, Lescot, and Bullant, the latter were, with de Lorme, at the service of Henri II and Charles IX. The reigns of Henri III and Henri IV, which profited little by the talents of Androuet du Cerceau and Bullant, lost the elegance and sculptural luxury of the works just completed: and the edifices of the *place* Dauphine and of the *place* royale at Paris may serve as types of the art of that period. The rage for building which prevailed under Louis XIII was not accompanied by the delicacy shewn in the works of 1515-74: but architecture, which had been paralysed by the intestine troubles before 1600, regained the enrichment lost since 1590, and took two strides; for the plan of the hôtel de Rambouillet became fashionable in conjunction with the style of the palais du Luxembourg. The houses in the Marais (round the *place* Royale) at Paris may serve as types of the art of that period in which the architecture of France was preparing to become decidedly French. The *style Louis XIV* absorbs from its predecessor the reputations of Le Mercier, F. Mansart, Le Muet, and Le Vau; while it claims for itself the talents of F. Blondel, Perrault, A. Le Pautre, Puget, L. Bruant, d'Aviler, J. H. Mansart, the elder de Cotte, Gabriel (the father), Boffrand, and Cartaud: the *place* des Victoires and the *place* de Vendôme, at Paris, may serve as types of the art of that period. The four architects last named, who extended their contemporaneous practice of half a century's duration, into the reign of Louis XVI, were so impressed by the novelties of plan introduced 1722 by Girardini at the palais Bourbon, and were so influenced by the favour shewn to the inventions of Oppenord, the '*père du genre rocaille*', as to be the representatives of the style Louis XV, which is seen in the houses of the faubourg S. Germain.

The influence of a better manner, introduced 1730 by Servandoni at the church of S. Sulpice, may have had some share in causing the establishment of an *atelier*, as a means of stopping the decadence, by J. F. Blondel, who, with Contant, was amongst the latest practitioners of repute in the national style as that is seen in the edifices of the faubourg S. Honoré. But although the revival of taste about 1750 had, twenty-five years later, a great share in causing a demand for a new style that should supersede the *style perruque* of the German critics (the *rococo* '*style Pompadour*', and '*style Dubarry*'), and should represent the anticipated progress of France in the reign of Louis XVI, nothing was produced that can better serve as a type of that period than the houses in the *chaussée d'Antin*. Putting aside the mannerism of Ledoux and the *anglo-manie* of Mique, the rococo was succeeded by the classicism of Soufflot, J. A. Gabriel (the son), and M. J. Peyre, with such other architects as, less fortunately, had to struggle through the revolutionary troubles and to see the *style Messidor*, like Boullée, De Wailly, Antoine, Legrand, Chalgrin, Molinos, Brongniart, Gondouin, Bonnard, Heurtier, A. F. Peyre, N. Durand, etc. The Empire was similarly determined to have a style of its own; and, after extinguishing the Egyptian fashion, reposed itself upon the well-drilled Grecian-Italian taste of Percier and Fontaine. That school, supported by

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Raymond, Hurtault, Poyet, Thibault, Rondelet, Labarre, Huyot, Guenepin, A. M. Peyre, the elder Vaudoyer, and Debret, not to mention living architects, such as it exhibited itself in the rue de la Paix and the rue de Rivoli, still maintains its ground, in spite of the attempts made in 1834 and afterwards, to recall the *style de la Renaissance* (François I) to life, or since 1837 to make available the resources of mediæval design.

The principal works by the architects above named will be mentioned in the biographical notices in this Dictionary; and illustrations of the periods of art from the commencement of the sixteenth century are furnished in the works by du Cerceau, Marot, Blondel, Krafft (considered unfaithful), Normand, and Gourlier.

There seems to be no view of the progress of art as applied to buildings in France, better than a series of articles in the *MAGASIN PITTORESQUE*, 1839-48; these were written by LE NOIR and VAUDoyer, and they contain copious references to the authors who have written on the various details of French archæology. These articles seem to have furnished the materials to AICARD, *Patria*, 8vo., Paris, 1847; and also to BORDIER et CHARTON, *Histoire de France*, etc., 8vo., Paris, 1859-60. The course of architecture in France has had so much influence upon that which it pursued in some other countries as to warrant the assertion, therefore, that its history has yet to be treated as it deserves; and the task would certainly not be a difficult one; for few nations have had the structures in their provinces so largely illustrated, or have produced so many architects who have published their designs.

As it is very remarkable that the internal decoration did not always correspond with the style adopted for architecture externally, it should be added that, after the *style de la Renaissance* lost the skill of du Cerceau and Pilon (1550-1600), a period of about half a century elapsed in which the decoration usually employed was either very thin Raffælesque foliage, as in the hands of Quevellerie and Carteron, or else an open-work and spiky imitation of it borrowed from Germany, as seen in the designs by Mignot; while the same country supplied the unnatural flowers which delighted the patrons of Lemercier and his school. From about 1640 till 1690 J. Le Pautre's works shew in purity the grand style of Louis XIV, that got poor before Oppenord appeared, about 1700, but lasted in that state till 1730. The best decoration in the *style Louis XV* is seen in the works of D. Marot, dated about 1710; but the *rococo Louis XV*, as practised by Watteau (1710-20), and in the decorations by Boffrand (1735-40), had sunk to its lowest depth under the efforts of Meissonnier and Germain, and was succeeded about 1750 by the *rocaille* of F. de Cuvillies. The chaos of decorative art resolved itself after the Revolution into a return to Raffælesque foliage and the classicism of Percier and Fontaine.

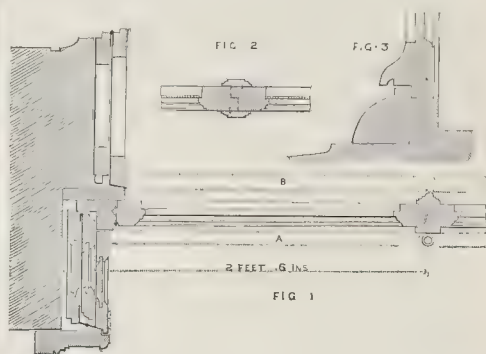
FRENCH ARCH. A term employed to designate the head, of an opening, when it is formed by bricks which do not have their joints radiating, but are simply packed upon the skewbacks, as constantly seen in bad work that is intended to be covered with cement.

FRENCH BRICK. The French method of brickmaking is detailed in *BRICK, Manufacture of*, p. 140.

FRENCH CASEMENT. A term applied to a casement that opens in two halves, each hung upon hinges, opening inwards, and closing together like a pair of folding doors, and secured when shut, on the inside, by an upright rod having a key at the top and bottom, called an *ESPAÑOLETTE BOLT*. These casements, as generally made in England, are not wind and water tight, in consequence of the want of accuracy in their manufacture; their success in France is proved for upwards of two hundred years. The advantages of the casement are great; when open, the whole space is made available for air, and the view through it is uninterrupted.

Fig. 1 represents a plan of a casement (*croisée*) complete,

with its shutters (*volets*) and exterior blinds (*persiennes*), as fitted to the large houses erected during and since 1858 in the principal streets of Paris. When it is desirable to close the window, the two halves are brought together, so that the



convex surface of one leaf fits into a hollow in the meeting style which forms part of the other; by a little force they are slipped one into the other; then the whole shuts into its place and is locked by the bolt. It will be noticed that the arrangement here shown admits of the blinds folding into the reveal; the ordinary mode is to fold back on to the face of the wall, to the injury of the architectural effect of the façade. A, the line of shutters when closed; B, that of the outside blinds.

Fig. 2 is an ordinary mode of forming the meeting style: another is given *s. v.* *Espagnolette bolt*. Fig. 3 is a section of the bottom of a casement and sill, as given in the *BUILDER Journal*, 1849, vii, 543, describing a French casement of a small size. Brown's patent for rendering French casements, etc., dust and watertight, is remarked upon in the same *Journal*, xviii, 372. **AFANBE. WATER-BAR.**

The accompanying woodcuts illustrate a new kind of water bar for French casements possessing many advantages, and which has proved successful in use for some years. It is also applicable to external doors, as when the water bar is forced down by the cover fillet, the apparatus offers no impediment to the foot, and when raised is absolutely weather-tight.

A, Section of a 2½ in. casement. B, Sill. C, Metal bead, with openings for an arm, D, to move through, as shewn in plan. E, Metal arm fixed to casement (one in the centre of each casement), to lift the water bar, F, in closing the casement. G, Metal water bar, hinged at H, lifted by the arm, D, and forced by it against G, a metal cover fillet fastened to the outside of the casement. F, shows the position of the water bar when the casement is open, to allow the cover fillet, G, to pass over it. This arrangement is found in practice to be most efficient, and to keep

for a long time in perfect working order. H. B. G.

FRENCH CHALK. An indurated magnesian mineral, which is used for drawing lines upon glass, cloth, etc.

FRENCH GLASS. The manufacture of glass in France was removed from Cherbourg in Normandy to Auxerre in Burgundy, and was afterwards established at Nevers in the Orleannois, and at S. Gobin, near la Fere, in Picardy. It was of a dirtyish green colour, and about 1703 held a place between London and Newcastle glass, in the proportion of 8d., 4d. and 3d. per foot superficial, being greener than the London glass, but more transparent and thinner than the Newcastle glass.

FRENCH GREY. A tint composed of white with ivory black, Indian red and Chinese blue.

FRENCH ORDER, see ORDER.

FRENCH PINK. A pigment made of Troyes (*i. e.*, Spanish) white with Avignon or French berries, *i. e.* the fruit of the buck-thorn. This, mixed with equal parts of ultramarine and white, makes a very useful green tint.

FRENCH POLISH. A glossy coating given to flat, or slightly curved, wooden surfaces. It consists of a resin or a gum-resin dissolved in spirit, without heat, generally in the proportion of one pound and a half of shell lac to one gallon of spirits of wine, an old recipe which seems to give the hardest and most durable polish; but copal, gum-arabic, mastic sandarach, seedlac, thus, etc., are sometimes introduced singly or together, according to the peculiar views of the maker. Benzine and guaiacum are also used, as well as dragon's blood, when particular tints are wanted; for there are few manufacturers who prepare similar tints: a light coloured polish is made with bleached or white lac, but it darkens upon exposure to daylight. The varnish is made more or less thick than it can be used (but always more fluid than the hardwood lacquer used for polishing turned work); and is thinned, before application, with spirits of wine. Before the varnish is put on the material, the wood is well smoothed with glass paper; and the varnish is then laid as evenly as possible under slight pressure with a rubber in steady sweeping strokes until the grain of the wood is filled up. After standing for two hours the material is again smoothed and polished with another coat. This operation may be repeated, if necessary, until the work looks nearly perfect. After a few days it will require one or two more repetitions of the process, and the last coat should be very thin; TOMLINSON, *Cyclopædia*, 8vo., London, 1852.

FRENCH SCAFFOLD. The name given to a scaffold made with balks of timber, more or less roughly squared and put together with braces, cheeks, flitches, straps, and bolts; so that the materials, being uniform in size or consecutively marked, can be taken asunder and used afresh as scaffolding for other work, or even be converted without great loss to the builder. It may be put together so as to carry travelling cranes; and may be used independently of any walling which, if the scaffold is (as usually erected) a double range of timbers, may be constructed either inside or outside the scaffolding; and thus there is no occasion for leaving holes in the wall to support the ends of putlogs. It is generally called a jenny scaffold by workmen; the term 'French' being considered to be improperly applied to it. The chief merit of this system, which was first practised in this country at the erection 1838-9 of the Reform Club-house, Pall Mall, and which may be seen in the scaffold for the Nelson memorial, given in the *CIVIL ENGINEER Journal*, 1843, vi, 409, was considered to exist in its strength and the prevention of accidents arising from insufficient poles and carelessly tied cordage.

FRENCH ULTRAMARINE. By this name two pigments are known, one being a madder blue (Fr. *bleu de garance*), the other being Prussian blue.

FRESCO. An Italian word, signifying 'fresh', which has been adopted in the English language to express the system of painting on plastering while it is soft or fresh. When the bricks or stones were good, and the mortar was uncontaminated, the wall was prepared for the stucco by being studded with stumps of horse-nails about six inches apart; no one seems to have thought of a hydrofuge such as pitch, but the first coat of stucco was laid in dry weather. It was composed, according to a recipe of the last century, of the powder of old rubbish stones, mixed with well burnt flint or lime, and water; "the saltiness of the lime being washed out by pouring off the water and putting fresh, the oftener the better." While the stucco was being prepared, the artist was getting ready a more or less coloured cartoon, and tracing it. As soon as the first coat was laid, the tracing was applied to the wall and transferred by means of a style. Then a coat of the same stuff, but only so thick as a half-crown, was laid each morning on so much space within the

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lines as was likely to be occupied by the painter on that day, and any lines so obliterated were lightly redrawn on the new surface. A free-handed artist, working quickly with brushes so long and so soft as not to rase or rake the plaster, laid full touches of flowing colour, which incorporated itself with the plaster and could be deepened but not rendered lighter. Hatching, by lines of darker colour, was possible if the artist, retiring to the point of view for his work, found greater depth desirable. Many colours were avoided (from their tendency to quarrel with the lime), earthy pigments being chiefly used, ground in lime-water, in milk, or in whey, and a large supply was kept upon the scaffold in pots that had each its large and small brush, and a pattern of the tint that the colour would give when dry. Of course a skilful hand could lay masses of a single tone in the appropriate places all over the picture before he proceeded to the use of another tint or hue. The preceding description of the process is in fact that stated (with the omission of sand, seven coats, and polishing) in the seventh book of VITRUVIUS, who is the only voucher for the antiquity of this system of painting which has been continued in Italy and the Tyrol to present time. SCRAFFITO may be considered as a corollary of the method. In describing mediæval buildings, it is not unusual to find paintings in distemper upon dry plaster described as fresco; so that it is difficult to be certain of the true nature of the "fresco-paintings, a curious specimen of that art in England at the commencement of the seventeenth century", said to exist in a bedroom at Bolsover castle; *Reports*, etc., of Associated Societies, etc., 1860, 240.

It is equally uncertain whether painting is meant in the passage "fresco-work is on the outside of a building, as FRET-work within", according to HATTON, *New View*, 12mo., London, 1708, p. 808. True fresco painting appears to have been nearly extinct in this country when the front of the house, now numbered 51 in Great Marlborough-street, was painted about 1787-90 in this process for Sheringham the decorator, who dwelt there, by foreign artists; the marks of the tool defining the imitations of dressings to the windows and many compartments of bassi-rilievi, chiefly copied from the loggie at the Vatican, are still visible beneath the present stone-coloured paint. At the same time J. F. Rigaud, R.A., was engaged in the repairs of true fresco-work at Buckingham House; it being the duty of the late J. B. Papworth, then engaged with Sheringham, to see the setting coat duly laid every morning. The term true fresco is here used because there is a bastard fresco, the two species being known to the Italians as *fresco-buono* and *fresco-secco*. The latter term is applied to painting on a dry setting coat which is rubbed with pumice stone and grounded, the evening before the painter works, by being washed with lime water. Fresco pictures, so called, have also been commenced in true fresco, and finished in distemper; and others have been partly executed as true fresco, while the remainder has been allowed to dry and has been finished in distemper. The details, advantages, and defects of these methods as noticed in the *Reports* of the Commissioners on the Fine Arts, 1842 and succeeding years, are, to some extent, reprinted in the *CIVIL ENGINEER Journal*, 1843, vi, 340, 389, where p. 431 may also be consulted. The old writers on fresco are mentioned by PAILLOT DE MONTABERT, *Traité complet de la Peinture*, 8vo., Paris, 1829, ix, 416-34, who has extracted perhaps all that might be useful in them. MÉRIMÉE, *Art*, translated by TAYLOR, 8vo., London, 1839; MERRIFIELD, *Art*, 8vo., London, 1846.

FRET. This word is improperly applied to the well known ornament formed of a single or multiple scroll broken into small fillets meeting each other at angles; notice of this decoration will be given in the article MÆANDER, under which term the French artists properly include it. The mediæval use of the word will here be considered.

To fret meant (if derived from the old Fr. *fréter*, to cross or interlace, as in ROQUEFORT, *Dict. s. v.*) 'to form reticulations', according to the application of the term by CHAUVER, 198, "a

fret of gold she had next her heare"; in this sense it is still employed by heralds, and this is the reason for the retention of the word in the terms DIAMOND FRET (Fr. *natte*), which is better termed a TRELLIS; the dovetail fret, and the embattled fret, are properly simple meanders. By 'to fret' was meant 'to raise', and subsequently 'to form into raised work', as appears from LYDGATE, who in his *Boccace*, cxxviii, says "a plaine table fret ful of nayles"; and in his *Boke of Troye*, "a crown of gold with rich stones yfrette." It has been disputed whether BOTONER, describing the two 'frette-vowted' windows on the south side of S. John's church at Bristol; and also the west door and the ceiling of S. Mary Redcliffe, of which he says 'fretted yn the hede' and 'altitudo voltae frettae archuatae' respectively; meant cusped, interlacing, or raised work. The first of these interpretations is supported by the ECCLESIOLOGIST *Journal*, 1846, v, 169, which wishes to use the term 'fretted vault' for a vault whose compartments are foliated; and by the GLOSSARY. The second of them is suggested by DALLAWAY, *Discourses*, 8vo., London, 1833, p. 172, who considers that 'frette-vowted' meant a vault broken into numerous intersections by longitudinal and transverse bands; in this sense the term might be applied to a coffered ceiling. The idea of raised work is, however, clearly supported by the statement of pictures made for dean Wren in fretwork by a plasterer, as noticed in the *Wiltshire Arch., etc., Mag.*, 8vo., Devizes, 1856, iii, 115-9; by the description of 'crocket and fretwork' in the accounts of the City churches given by WREN, *Parentalia*, fol., London, 1750, pp. 309-18; and by the continued use of the term in the time of NEVE, *Dict.*, 1703, who, speaking of the 'plastique art or work of the plasterer', whether exercised in modelling or in stamping the stucco, says "the chief use with us is in the graceful fretting of roofs (commonly known amongst us by the name of fretwork)"; and in a third edition, 1736, he observes "fretwork is principally wrought by plasterers in ceilings, roofs, etc." Similar testimony is given s. v. FRESCO, from HATTON, *New View*, 12mo., London, 1708, who also, p. 806-8, says that while crocket work is 'the moldings done by plasterers forming panels, etc.', fretwork is 'the flowers, fruit, leaves, etc., made in plaster in churches and rooms of state, etc.'

FREY (JOSEPH), born 1758 at Mannheim; obtained 1796 the rank of captain; and built at Munich the forage storehouse on the Isar for count Rumford; the carriage dépôt in the Lehel; the artillery workshop at the Kostthor; the barracks in the Hofgarten; the arsenal; and several other structures. He was alive in 1810. 68.

FREYBERG in Saxony, see FREIBERG.

FREYBURG in Baden, and in Saxony, see FREIBURG.

FREYBURG in Switzerland, see FRIBOURG.

FREYBURG (GEORGE VON). A rhyming Danish epitaph in the church of the small town of Slangstrup, about five miles from Friderichsborg, given by DE THURAH, *Vitruvius Danicus*, fol., Copenhagen, 1746, ii, 5, announces that Joergen von Friberg (translated Fr. Fribourg, Ger. Freyburg) carved the crucifix which accompanies it; and that he had not only been the *baumeister* of this church, but also of the chateau at Friderichsborg.

FREYSING, in Bavaria, see FREISING.

FRIARY. A religious establishment consisting of various ecclesiastical and domestic buildings for the use of the several bodies called *fratres* or friars. It is used in contradistinction to 'monastery', which is more strictly applied to those inhabited by monks. The difference being that the former bodies were always actively employed in the world in begging, teaching, or preaching, while the monks were confined to the precincts of the monastery.

A. A.

The inhabitants of a friary are divided into the classes of lay, novice, and professed, brothers; the latter being bound by the usual monastic vows of chastity, obedience, and poverty. The four orders, as they were called, viz. the Augustinian

monks or Austin Friars; the Carmelite monks or White Friars; the Dominican monks or Black, or Preaching, Friars; and the Franciscan monks or Grey, or Mendicant, Friars, have had their establishments already noticed. The history of these orders and of their subdivisions, with that of less important fraternities, such as the Crutched Friars; the Friars of the Penitence or of the Sack; the Friars of Bethlehem; and the Friars of the Holy Trinity or of the Redemption of Captives, may be learnt from the writers noticed under each term, by LENGLET DU FRESNOY, *Méthode pour étudier l'histoire*, 4to., Paris, 1735, iii, *passim*.

FRIAS (NICOLAS DE), who is mentioned with praise by BARBOSA MACHADO, and by CYRILLO, was architect to the king of Portugal before 1610, in which year his son Luis obtained that title and his father became master of the works at the royal palaces; a rank which Luis held in 1630. 88.

FRIBORG (JOERGEN VON), see FREYBURG (GEORGE VON).

FRIBOURG, or FREIBURG IM UERCHTLAND, or FREYBURG. The capital of the canton of the same name in Switzerland. The town, which is the residence of the bishop of Lausanne, still retains its ancient fortifications of tall embattled walls with watch towers and gates. The houses, chiefly built of stone, offer nothing peculiarly interesting except where their roofs in one street serve as pavement to another. The collegiate church of S. Nicolas, erected 1280-1500, is chiefly in the Flamboyant style, and had its exterior restored 1856; the tower and spire (240 ft. high) rise over a portal dated 1452. The large and single-naved church of the Bärfsusser, another having a circular plan and a dome, the church of S. John, and that of the Capuchins, with the richly decorated church formerly belonging to the Jesuits, and their college rising above all the other buildings, are the chief buildings of importance except the *rath-haus*, and the modern court-house. The celebrated wire bridge, said to be 905 ft. long (another account makes the length between the piers 840 ft.), 23 ft. wide, and 180 ft. above the Saane, was constructed 1830-38, at a cost of £24,000; another, completed 1840, is 640 ft. long and 317 ft. above the current. BAUZEITUNG, ser. i, pl. 75; HAHN, *Bridges*, p. 98 and clx; ILLUSTRATED LONDON NEWS, 1847, xi, 361-4. 18. 50.

FRIBOURG in Baden, see FREIBURG.

FRICENTO or FRIGENTO. A city much damaged by earthquakes 1688 and 1736, in the province of Principato Ulteriore in the kingdom of Naples. The cathedral is dedicated to the Virgin and S. Marciano.

FRICITION. The action of two substances sliding in close contact over one another is called friction, and is produced by the attrition of the various inequalities of their surfaces. According to the nature of this motion, the resistance of friction is known by the names of the *sliding*, or of the *rolling*, *friction*; and the general laws affecting those actions may be briefly stated as follows: 1. Sliding friction produces a much greater resistance than rolling friction; 2. The friction increases directly in proportion to the surfaces working upon one another, but is independent of the velocity of motion; 3. The resistance from friction increases in the direct ratio of the weights of the respective moving bodies; 4. But, all other things being equal, the friction increases more rapidly with the increase of pressure, due to weight, than it does to the increase of the surfaces of contact; 5. Friction of both descriptions is diminished by covering the surfaces of contact with some soft unctuous substance which may serve to fill up the inequalities of the natural surfaces, and tend to render the higher portions more slippery.

The laws of friction more immediately affect the operations of the machinist or of the mechanical engineer; the architect has to consider the friction of hinges, of sliding shutters, of lifts; and in all hoisting apparatus the friction and rigidity of cordage must be taken very seriously into account: all these are treated by MORIN, *Leçons de mécanique pratique*, 8vo., Paris, 1846; MORIN, *Nouvelles expériences sur le frottement*, 4to., Paris, 1833, who gives some very elaborate tables of the

value of the friction of various substances: it must, however, always be understood that accidental circumstances would have great influence upon the normal laws indicated in them. *Mémoire* in vol. x of the *Savans Etrangers* by COULOMB, in 1781; and essays by VINCE and G. RENNIE, in the *Philosophical Transactions* for 1785 and for 1829. LUBRICATION.

FRIEDBERGER (EBERHARD) of Frankfurt was engaged with meister Weltz as *baumeister* upon the chapel of the Virgin, erected 1377-1409 at Wurtzburg. 92.

FRIEZE, formerly also written FREEZE, FRIZE, and FRISE. (It. *fregio*; Sp. *friso*; Fr. *frise*; Ger. *fries*). This term, which is now restricted to the space that exists between the architrave and the cornice in the entablature of classic and of neo-classic work, was evidently applied to the space in question because that was the situation for the most important decoration of the entablature. FREESING. The term is, philologically, applicable to any surface decorated by the sculptor or the painter; thus, the ornamental face of some archivolt in Romanesque work, and the sculpture under the windows of the chapter house at Salisbury, as well as the band for pateras round the doorway of the Erechtheum, and the procession belonging to the cella of the Parthenon, were justly called friezes, and any wide horizontal band of like character also deserves the name. In the Doric order, the frieze of the temple to Ceres at Paestum is, perhaps, the only antique example of one that is perfectly plain; the use of wreaths instead of triglyphs occurred on the monument of Thrasyllus at Athens. The employment of triglyphs need not be further noticed in this article, except as regards the overloaded example, preserved in the walls of the cathedral at Athens, which has a CAPEDO or other ornament in front of each triglyph. The term *zophorus* (Gr. *ζωφόρος*), by which the ancients expressed the frieze when sculptured with figures or animals as in the choragic monument of Lysicrates at Athens, over columns (hyperthyrum being their term for it over a door), is merited by the sculptured portions between the triglyphs of the Parthenon and the Theseum (Doric); by the sculptures between the architrave and the cornice of the temples on the Ilissus and at Bassæ (Ionic); by that on the Forum of Nerva (Corinthian); and by that of the arch of Titus (Composite). The festoons connecting genii with candelabra on the frieze of the temple to Fortuna Virilis (Ionic); or those connecting bucrania on that of Vesta at Tivoli; together with the griffins and candelabra of the temple to Antoninus and Faustina, and the great scroll of foliage on the frontispiece of Nero, stand midway in interest between the figures of the examples previously mentioned and the fluted frieze of the upper theatre at Cnidus and of the Incantada at Salonica (these are all Corinthian). As connected with the subject of the enrichment of this portion of the entablature, reference should be made to the decorations of friezes given in CASSAS, *Voy. Pitt. de Syrie*, fol., Paris, 1798; and to the frieze at Aizani, shewn in TEXIER, *Asie Mineure*, fol., Paris, 1838. ANTEPIEUM.

In measuring the height of the frieze, VITRUVIUS, iii, 3, and iv, 3, includes the capping of it. In studying the construction of antique friezes, notice should be taken of the internal joints as managed at the temple of Nemesis at Rhamnus; and of the upper and lower terminations of the frieze. Thus, in the Ionic order of the theatre of Marcellus, the capping has a sculptured ovolo worked out of the same stone as the frieze; and, as well as in the same order to the propylæa of Minerva Polias at Priene, the capping has a sort of apothesis between it and the general face of the frieze. The same curve occurs in the Corinthian order in the temple of the Winds and the Frontispiece of Nero: while the frieze dies by an apophysis on to the cymatium of the architrave in the temples of Jupiter Olympius and of Jupiter Tonans (Corinthian), and in the arch of Septimius Severus, and in the baths of Diocletian (Composite). The S or oggee profile of the frieze at the Incantada appears to be exceptional; but the C or cushion, or pulvinate profile of

the baths of Diocletian (Ionic) has been frequently imitated by the architects of the Revival, and in modern times. It seems not unlikely that the pulvinate frieze originated accidentally; in stone being left on the face to admit of subsequent carving, which carving had never been executed. The swell should never be great or it will look heavy. Examples are not wanting in ancient remains of the total omission of the frieze, as in the entablature supported by the caryatides of the Erechtheum, and in the dressings of the windows to the temple of Vesta at Tivoli.

FRIEZE PANELS. The upper panels of a six-panelled door, or framing. 2.

FRIEZE RAIL. The upper rail but one of a six-panelled door, or framing. 2.

FRIGIDARIUM. The apartment, in the ancient thermæ, which served as a cooling room; and which, in the smaller buildings devoted to bathing purposes, probably had closets around it so as to serve at the same time as an APODYTERIUM. The term is sometimes used to denote the *frigida lavatio*, i. e., the cold bath itself, which may have been in this room. The *frigida natatio* was of course a piscina or pool for swimmers. In large establishments there was an *elæothesium frigidarium*, or cold anointing room, attached to this apartment. *Detached Essays, Baths and Washhouses*, pp. 7 and 8.

FRIGIMELICA (It. CONDE), a nobleman of Padua, designed the church of S. Gaetano at Vicenza, finished 1730, which is sometimes ascribed to Guarini. 3.

FRISIUS or FRYSIUS, see VREDEMAN (HANS).

FRISONE (MARCO DA) is supposed by GIULINI, *Memorie*, 4to., Milan, 1760, xi, 436-40, to have been the same person as Marco da Campione, and consequently the designer or first architect of the cathedral at Milan, because no notice of any other Marco occurs in the list of architects to that edifice until 8 July 1390, when it states that "magister Marchus de Frixono inzignerius fabrice decessit die suprascripto circa horam Avemarie in mane et corpus ejus sepultum fuit honorifice in ecclesia Sancte Thecle ipsa die post prandium."

FRISONI (. . . .) entered 1730 the service of the Duke Eberhard Lewis of Würtemberg; and in conjunction with Retti, built the palace (one of the largest in Germany) called Ludwigsburg, which was the subject of twenty-six plates engraved by Corvinus. 68.

FRISSINGEN (ULRICH VON). This is the manner in which FRANCHETTI, *Storia del Duomo*, 4to., Milan, 1821, p. 140, and OTTE, *Handbuch*, 8vo., Leipzig, 1854, p. 176, write the name of the architect who is noticed in this Dictionary s. v. Fissengen, in accordance with the method adopted by GIULINI, *Memorie*, 4to., Milan, 1760, p. 453; and by Von der HAGEN, *Briefe*, 12mo., Breslau, 1818, i, 264; the latter supposes him to be the same as Ulrich von Ensingen, which WEYERMANN, *Neue Nachrichten*, 8vo., Ulm, 1829, p. 82, assumes as certain. JAEGER, *Schwabisches Stadtweesen*, 8vo., Stuttgart, 1831, p. 570, calls him Feistingen, but he probably belonged to FREISING or FRISINGEN. ENSINGER.

FRIT. The name given by glass makers to the result of a preliminary and incomplete fusion to which it was formerly the custom to expose some of the constituents of the glass. At the present day the 'fritting' is seldom resorted to. Chemists attach importance to this process, on account of the facilities it offers for a perfect combination between the silica and the various bases which enter into the composition of the glass; and of its favouring the disengagement of the carbonic acid gas. It is, however, a costly process, both by reason of the expense of raising the materials to the requisite temperature, and of the subsequent mixture with the other elements; and as the careful conduct of the furnace will dispense with the necessity for this preliminary operation, it is now rarely effected. G. R. B.

FRIZE, see FRIEZE.

FRÖESCHL (MARTIN), baumeister 1524 at the church of S. Stephen in Vienna, made a drawing for a sakraments-haus, which is still preserved in that city. 26.

FRÖILACO built, 1122-33, the monastery of S. Juan de Carouca, about six miles from Lamego in Portugal, according to an inscription at the door of its church, of which church the doorway only was existing at the end of the last century. 66.

FRONT. This word, formerly also called FRONTISPIECE, means the face of a building, in such terms as fore-front, return-front, side-front, rear or back-front, and inner-front: but it is generally applied to the principal façade, in which the entrance is usually placed, and thus the terms front-door, front-room, front-wall arise; but in several cases the front of a church is the west end, although there is no door in that part. The Cottonian MS., Nero D 7, citing the 'opus frontale nostræ ecclesiæ', or west end of the church, at S. Alban's, shews that the use of the term for the east end in the SURTEES SOCIETY, *Description*, 8vo., London, 1844, p. 1, in the passage 'in the front or highest part of the church were the nine altars', 1593, is not a reverential use of the word as has been supposed, but merely the way in which the writer expressed the fact that the altars faced the writer standing as he entered, in the same way that it is usual to speak of seats in a theatre or concert room as front-boxes or front-seats with reference to their position as regards the stage, etc.

In order that supplicants should look towards the east, VITRUVIUS, iv, 5, says that the front of a temple should have a western aspect; but he allows that if the nature of the site should prevent this position, the front should be so placed that the greater part of the city should be seen from it: he adds that a temple built on the bank of a river, or on the side of a road, should have the front towards passengers. It has been supposed that some of the early bishops permitted the practice to remain in order that they might at once occupy the temples as churches; while others placed the fronts of their altered or new buildings to the east, in order to oppose a superstitious feeling; thus the cathedrals at Pavia and at Rome, with the basilicas of S. Giovanni Laterano and of Sta. Maria in Trastevere, in the latter city, have east fronts. S. PAULINUS, *Ep. ad Severum*; S. CAROLUS BORROMÆUS, *Instit. Eccles. Fabricæ*.

FRONTAL. A word which in NEVE, *Dict.*, 1736, is applied to 'a little pediment over a door or window', but which is now only employed as the equivalent of the late Lat. *antependium* (apparently adopted for this purpose first by BAST, *Notice sur Van Eyck*), *frontella*; It. *frontale*, *pala*, *paleotto*; Sp. *frontal*, *frontalera*; Fr. *devant d'autel*, *frontale*, *frontier*, *nappe d'autel*; Ger. *altartuch*, to signify the moveable decoration exhibited in front of an altar from the table downwards: it is remarkable that many French writers call it erroneously 'retable'. Originally it was a piece of silk, velvet, or cloth of gold, frequently embroidered and set with pearls: afterwards it was of wood, carved, painted, gilt, and often set with crystals; but this material was sometimes superseded by metal embossed and adorned with enamels and jewels. A specimen of the second class may still be found in Westminster Abbey, and in many an Italian church; in the latter country the chief part of the decoration is often an important picture. The objects of this sort that interest the architect are, however, chiefly such as those in the following list: SEROUX D'AGINCOURT, *Hist.*, ii, pl. 26, gives a representation of the frontal presented about 835-60 to the church of S. Ambrogio at Milan, which has a gold front, and silver sides and back, enamelled and set with precious stones; the *pala d'oro* of silvergilt with enamels and gems in the church of S. Mark at Venice, dating 976, but restored 1105, 1209, and 1345; the silver *pala*, 1344, which was used to cover it; that made probably in the tenth century, of silvergilt, and still preserved in the treasury of the cathedral at Monza; that of gold, made 1019 and sold 1334, from the cathedral at Basle, and now in the Musée de Cluny, represented

in GAILHABAUD, *L'Arch.*, iv; one of bronze, with mosaics, at Comburg in Wurtemberg, engraved in BOISSERÉE, *Mons.*, fol., Munich, 1842, pl. 27, and GAILHABAUD, *Mons.*, ii, which is about 6 ft. 10 ins. long and 2 ft. 8 ins. high: another of chased silver, given about 1144 to the cathedral at Citta del Castello, in D'AGINCOURT, ii, pl. 21: and one of stone from the church at S. Germer, made in the thirteenth or fourteenth century, and now in the Musée de Cluny, illustrated in GAILHABAUD *L'Arch.*, iv.

FRONTISH DOOR. A term apparently applied to doors of 'great buildings having their ornaments as pilasters, etc.' 4.

FRONTISPIECE, sometimes written FRONTISHPIECE. The principal ornamented front of a building, but more usually applied to a decorated entrance, i. e., doorway, where it answers to the Fr. *portail*; and to the pediment or projecting covering of a door. BLONDEL, *Cours*, 8vo., Paris, 1771, i, 287, notes that a portico is a sort of frontispiece; thus, people say 'the frontispiece of a temple' instead of 'the portico of a church'. The word frontispiece is also applied to the external decoration of the door of a palace or public edifice, as in the case of the frontispiece of the palais du Luxembourg, facing the rue de Tournon: but the front of the Louvre towards S. Germain l'Auxerrois is called a façade; for in general, frontispiece is understood to mean a piece of architecture announcing the entrance, destination, and importance of a building, but therefore distinguished, to some extent, from the principal mass of it. The piece of decoration (Fr. *attique de cheminée*) placed in the style de la Renaissance and later, over the mantel of a fire place, was also called by English authors a frontispiece.

The portico of Nero at Rome has been called in England the frontispiece of Nero, at least from the time of the translation 1664 by EVELYN of FREART DE CHAMBRAI, *Parallèle*, fol., Paris, 1650.

FRONTON. The French term for a pediment, adopted by old writers in England; thus NEVE, *Dict.*, 1736 s. v., says it is 'an ornament over a door, niche, etc., also called a pediment'. FIRMS.

FROSINI (DONATO) constructed, 1608-16, the church of Sta. Maria della Neve in his native city of Pistoia. 112.

FROST, see FREEZING.

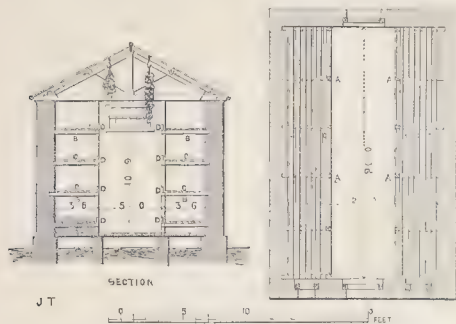
FROWEY TIMBER. Timber was, by some workmen, said to be frowey, when evenly tempered all the way, and worked freely without tearing: GWILT, *Dict.*, s. v., says such as has its grain in the same direction as that in which the plane is worked; but WEALE, *Rud. Dict.*, says that frowey stuff is 'short or brittle and soft timber'. 1. 4.

FRUCTUS, see OCTAVIUS PAL. FRUCTUS (C.)

FRUIT. It is remarkable that the list of fruits employed in sculptured ornament has been very limited: setting aside the pomegranate and the almond, it is not easy to mention more than the pine-cone, the acorn, and the grape as constantly occurring, except in the case of festoons, which, as at the Pantheon, embrace various local fruits, etc. ECHINUS.

FRUIT ROOM. A shed or room specially fitted up for the preservation of apples, pears, and other fruit of like character. The woodcut illustrates an example of such a structure erected many years, fully answering its purpose. A, posts 3 ins. square, placed 4 ft. apart, to which are secured at one end, B, bearers 3 ins. square, and let into the wall at the other; on these are laid C, strips 3 ins. by 1 in., $1\frac{1}{2}$ ins. apart; along the face of each shelf are D, rails 7 ins. high and 1 in. thick, the shelves being 2 ft. 6 ins. from top to top of bearers. The walls are of brick, 1 ft. 6 ins. thick, and limewhitened; the floor of stone. The roof being open, affords space for herbs, etc., to hang from the rafters. The wood used should be free from turpentine, white deal is the best. No straw or other layer should be used, as it obstructs free circulation of air between the strips: the small windows at each end, for thorough ventilation of the room, should have the sashes hung on pivots. The bottom space, E,

may be filled with manure for mushrooms when required, the shelf being then removed. A short notice of some other points is given *s. v.* APPLE ROOM. J. T.



The fruit room at the Horticultural Gardens at Chiswick is described as being "large, and situated at the back of a peach wall. It has a north-westerly aspect, and is entered through another small room, so as never to admit the external air when it is wished to be excluded. It is generally kept almost dark, and just sufficiently ventilated to carry off the moisture which exhales from the fruit without drying the air so much as to cause the articles to shrivel, the windows being matted up in winter to keep out the frost, and no fire heat employed. The fruit is laid on shelves, arranged in tiers and formed of strips of wood about three inches wide, with small openings between. The more valuable sorts of pear are wrapped individually in soft paper"; WEALE, *London and its Vicinity*, 8vo., 1851, p. 482. Reference may be made to the articles ICEWELL and SILO.

FRUSTUM. A term used for that part of a solid body which is left next the base when the top is cut away: it is also employed by some writers for any part of any solid, such as a cone or a pyramid, which is contained between two planes that may be either parallel or inclined to each other; and is applied by writers on architecture to any such body, as the shaft of a monolithic column, or to each drum (so sometimes called from the *Fr. tambour*) of a shaft that consists of several pieces, each taking the whole diameter. **DRUM.**

FUCCIO or **FUCIUS.** This name occurs in *VASARI, Vite*, s. v. Niccola da Pisa, as belonging to an architect; but his dates are so incorrect, that the objections to his account, here somewhat amended in that respect, are given in their respective places. This author says that Fuccio went from Florence to Rome about 1231, at the time when the emperor Frederick was crowned by pope Honorius (*s. e.*, 1221), and with that monarch from Rome to Naples, where he finished the Castel Capuano, now called the Vicaria, and the Castel dell' Uovo, both designed by Buono; but *SIGISMONDO, Descr.*, 8vo., Naples, 1788, attributes this completion to Niccola da Pisa. *VASARI* adds that he founded the towers, and erected the gate which commands the Volturno, for the city of Capua; laid out a chase for the sport of fowling near Gravina, and another for hunting in winter at Melfi, etc. All this is preceded by the statement of the same writer that Fuccio built, 1229, the church of Sta. Maria sopr' Arno at Florence; and that he also executed the tomb of a queen of Cyprus in the church of S. Francesco at Assisi. But *FANTOZZI, Guida*, 12mo., Florence, 1842, p. 591-3, explains that the church could only have been altered or restored at that time; and that an inscription of doubtful authority, *FUCCIO MI FECI MCCXXIX*, may have been mistaken: while *VON DER HAGEN, Briefe*, 12mo., Breslau, 1818, iii, 146, iv, 352, considers with *CICOGNARA, Storia*, i, 374, that the existence of this Fuccio is very doubtful. The work at Assisi is now supposed to be the tomb of John de Brienne, king of Jerusalem, who died 1237.

ARCH. PUB. SOC.

FUCINUS LACUS, see **EMISSARIUM**.

FUFICIUS is mentioned, without any notice of his period, as the earliest Roman author on architectural subjects, by *VITRUVIUS*, vii, preface. This mode of writing the name is adopted from the Harl. MSS. 2767 (ninth century) and, with one exception, the other MS. in the British Museum; Fufidius has been suggested by *SCHNEIDER*, and Fuffisius (? Fuffitius), Fufstius, Fuitius, Fussitius, with even Suffitius, Sufficus (Harl. MS. 2508), and Susfitius have been suggested.

FUGA (**FERDINANDO**), born in November 1699 at Florence of parents in good station, was placed 1711 as pupil with G. B. Foggini, and sent 1717 to Rome, where he married, about 1728, according to *MILIZIA, s. v.*, whose sketch has generally been copied, but which differs considerably from the account, evidently autobiographical, which forms great part of the dedication to Fuga himself of the first part of the thirteenth volume of the *SERIE DEGLI UOMINI*, 4to., Florence, 1776, accompanied by his portrait by Cecchi after Pellegrino. That account is here followed so far as it goes. Fuga probably took to Rome recommendations from his godfather, the hereditary prince of Florence, to the cardinals del Giudice, one of whom, perhaps the elder, sent him to erect a public chapel in the portico of his palazzo di Cellamare (? at Naples); and about 1728 was invited to Palermo by the municipality to execute several works, but it would seem that he had only designed a bridge over the Milcia (which he left to be constructed by somebody else), as he returned to Rome upon the accession, 1730, of Clement XII (Corsini), who made the younger and surviving cardinal del Giudice his majordomo, and gave Fuga an appointment as one of the two architects to the papal palaces: in that capacity he was employed to finish the fabbrica della Consulta (plan and view of the cortile, in *LETAROUILLY*, pl. 29-30) on the Quirinal, opposite the pontifical palace, which not only included the apartments for the cardinal secretary of the Briefs, and for the secretary of the Consulta, with their clerks and servants, but quarters for the officers and men of two bodies (cavalleggieri and corazze) of the papal guard, inclusive of stabling for one hundred and fifty horses each. This work was so successful that Fuga was made a *cavaliere di Cristo*, and on the death of Juvarra was requested by Philip V, in a letter dated 12 June, 1735, to go to Spain as chief royal architect to build the new palace at Madrid. But Fuga, who could (or perhaps would) not obtain leave to quit the service of the pope, was directed to construct the great addition to the wing of the pontifical palace, reaching towards the corner of the via delle Quattro Fontane, which terminates with the apartments for the secretary of the Cypher and for the captain of the Swiss Guard; as well as to complete the great stables begun under Innocent XIII (1721-4) by A. Specchi over the quarters of the papal guard, *soldati rossi*, in front of the palace. *MILIZIA* adds that not far from this last work Fuga designed the coach-houses, etc., for the papal mews in the Contrada del Boschetto. He completed the elliptically-planned church of Sta. Maria dell' Orazione or della Morte in the strada Giulia; the church of the Bambino, of which C. Buratti had already laid the foundations, for the Jesuits, near the church of Sta. Maria Maggiore, adding on one side the college, and on the other the residences of the members; and the prison for women at the porta Portese, with the dwellings for those females and gaolers. Amongst many other works he then completed the palazzo Petroni in the piazza del Gesù, and the palazzo Corsini (*LETAROUILLY*, pl. 191-2, p. 405-9) in the Longara at Rome; and about this period designed the church of the nunnery of Sta. Caterina della Ruota at Aquila; and completed (*MILIZIA* says designed) the prison at Frosinone.

After the accession, 1740, of Benedict XIV, Fuga was employed at Rome to restore the church of Sta. Maria Maggiore, where he rebuilt the ailes, added the papal altar, in which he used four antique columns of porphyry, and designed the façade with its portico and loggia for the ceremony of the Benediction, putting

the scala regia to that loggia, and the sacristy with apartments over it for the clergy; (LETAROUILLY, pl. 305-8). He then finished the summer-house or il Ritiro, then called the *caffaeus*, in the papal gardens on the Quirinal; enlarged the hospital of S. Spirito in Sassia, adding a wing with the anatomical theatre, etc., for students and attendants on the opposite side towards the via Longara; made additions to the asylum for illegitimate female children, next to the church of that hospital; formed the cemetery of S. Spirito with its chapel, etc., opposite the villa Barberini; and designed the church of S. Apollinare, with the adjacent German-Hungarian college, and the triclino Leoniano (LETAROUILLY, pl. 225), attached to the scala santa of S. Giovanni Laterano, with apartments for the penitenzieri of that church. MILIZIA adds that Fuga executed other works at Rome especially for the church of S. Giacomo degli Spagnuoli, and therein the obsequies of queen Maria Amelia of Spain (ob. 1760). These seem to have led to his appointment as first architect at Naples, in order to design the reale Albergo dei Poveri or great hospital del reclusorio, founded 1751, for eight thousand poor persons, of which about three-fifths are now completed; and to execute 1762-3 at Trivice (MILIZIA says Tredice), near the ospedale degli Incurabili, about a mile from Naples, a cemetery which cost 48,500 ducats, having three hundred and sixty-eight graves, and a chapel with residences for priests, etc. He then designed the palazzo Giordani, opposite the Spedaleto, and near it the very large palazzo Caramanica, which, with continual employment upon the royal palaces and villas, are the last works mentioned in the above-named dedication. MILIZIA adds that he began the large building, still incomplete, and called the Granili, at the sea-shore, near the ponte della Maddalena, to contain under one roof a public granary, an arsenal for artillery, and a storehouse for rigging; that he designed the villa Jaci at Resina near Portici; and made designs, which were partly put into execution including the addition of a cupola, for restoring the cathedral at Palermo. SIGISMONDO, *Descr.*, 8vo., Naples, 1788-9, adds that he conducted the restoration, costing 20,000 ducats, of the chiesa de' Gelormini (Girolomini) for the PP. dell' Oratorio; and designed the great altar, erected 1777, in the Theatine church of the SS. Apostoli (which has been removed into the church of S. Filippo Neri), as well as that in the Theatine church of S. Paolo. It appears that Fuga also designed the tomb for Innocent XII, executed 1746 by Valle in S. Peter's; restored 1763 the front of the Casino de' Nobili, constructed 1309 by Duccio at Siena; and retired to Florence, where he died 7 February 1782. 3. 30. 84. 95.

FUGGINI (G.) or FUGINI, see FOGGINI (G. B.)

FULCRUM. A term in mechanics expressing the axis, or the point of support to the action of a lever, which modifies essentially the value of the action itself. In a lever of the first kind, the fulcrum is between the power and the weight; in one of the second kind, the weight is placed between the power and the fulcrum; in a lever of the third kind, the power is between the fulcrum and the weight. In all these cases the moment of the power is ascertained by multiplying the force applied to the lever by its distance from the fulcrum; and the moment of the weight, by multiplying the weight by its distance from the fulcrum. In other words, the proportions of the power to the weight is as those of their respective distances from the fulcrum. G. R. B.

FULDA. A city situate on the river of the same name in the electorate of Hesse-Cassel, in Western Germany. It consists of old houses in narrow streets; and is surrounded by decayed walls separating it from eight suburbs. There are three bridges; and although it once contained four parish churches, and several monastic establishments which have been mostly turned to secular purposes, the chief structures now are the cathedral, dedicated to S. Salvador, erected 1700-12 (a model was supplied by C. Fontana) except the crypt; the round church of S. Michael, with a crypt of about the ninth century,

having a central pillar crowned by a rude Ionic capital, while the tower and nave date about 1092; the church of S. Severus; a Benedictine nunnery; the episcopal (now electoral) palace; a college; an asylum for orphans and widows; and a house of correction. An old château is distant about three miles. 28. 50. 96.

FULL. An expression used by artificers, in taking dimensions, to signify that any substance measures more than what they assign to it by a dimension less than a sixteenth of an inch, which is the smallest fraction of the foot used by them. When it measures less than the dimension named, they say the length runs 'bare'.

FULLONICA. The Latin term for a scouring-house, or a fuller's wash-house and premises. One entered from the street of the Mercuries was discovered at Pompeii, in the island of houses that contains the house of the Tragic Poet, and is described in the *Musæo Borbonico*, 8vo., Naples, 1827, iv, pl. 48-50; and in *GELL.*, *Pompeiana*, 4to., London, 1832, i, 189. The name was suggested for a dark vault with a basin and five cells, which are ambiguously described in the *ATHENÆUM Journal*, 1857, p. 885, on their discovery in connection with the baths at the Stabian gate of the same town; whereas an inscription in one of the rooms seems to call them a *destrictarium* and *laconicum*.

FUMARIUM. A Latin word which may be considered to mean a chamber into which the flues of the furnaces of a house conducted the heated air and smoke before they found a vent into the open air. According to COLUMELLA, i, it seems to have been used for making wood dry enough for fuel, and for ripening wine; the wine being either placed in the fumarium, or in the apotheca in connection with, or over, it.

FUMERELL, also written *fummerell*, and *fummerelle*, see FEMERALL.

FUMIGATION. This term, derived from the process of obtaining fumes by burning pastiles or aromatic substances to disguise unpleasant odours, formerly a very common method of attempting disinfection, is now often, though improperly, used for the application of such gases or vapours as by their chemical action convert dangerous miasmata into innocuous matter. The vapour of burning sulphur, *i.e.* sulphurous acid gas, and chlorine gas, appear to have been first recommended as disinfectants about 1758, muriatic acid gas and nitric acid gas about 1773. When it is desirable to produce a great effect in a short time, chlorine gas is best obtained by the usual method of mixing sulphuric acid, binoxide of manganese, and common salt: when a less violent action may suffice, chloride of lime may be used if a hundred times its weight of water is added to the powder, and the solution (when clear) exposed in flat vessels to the infected air; the action may be quickened by the addition of a little vinegar, or of a few drops of muriatic acid. For cesspools, etc., the pure powder may be used, as already noticed with other applications *s. v.* DEODORIZER.

The following is the description of a plan adopted on a large scale. FARADAY, in the *QUARTERLY JOURNAL*, 8vo., London, 1825, xviii, p. 92, gives the mode of fumigating the Penitentiary at Millbank, Westminster: 2,000,000 cubic ft. of air were cleansed by the chlorine gas obtained from 700 lbs. of powdered salt and 700 lbs. of oxide (? binoxide) of manganese, with 1400 lbs. of oil of vitriol (sulphuric acid) diluted by ten measures of water being put into a tub to which nine half-measures of acid were added, and when the liquid had cooled, nine more half-measures of acid were added. All apertures, especially keyholes, being stopped, and earthen dishes holding about a gallon each being distributed into their necessary places, each pan was charged with about 3½ lbs. of the mixed salt and manganese; and the diluted acid, being cold, was measured out of jars at the rate of about 4½ lbs. to each pan, and the stuff was then stirred with a stick. All this was done without inconvenience except when the acid was too warm. In a few minutes the general diffusion of chlorine was evident;

in half an hour it was injudicious to enter the loaded atmosphere, and up to the fifth day the yellow tint could be discerned. After the sixth day the pans were removed, though sometimes with difficulty, and employed, with fresh material, elsewhere in the building. The structure consisted of seventy-two galleries, each 150 ft. in length, besides towers, passages, chapel, etc., equivalent to thirteen such galleries; and the number of cells, etc., was about twelve hundred. It will be seen that the proportions *by weight* were acid 2, manganese 1, salt 1, and water 1: and it was estimated that each pan of about 7½ lbs. of mixture would give 1 lb. or 5½ cubic ft. of chlorine gas; but it appears to have been the opinion of the eminent chemist that from a quarter to a half of the quantity of gas would suffice for any of the usual cases in which fumigation might be needed.

FUNCHAL. The capital of the island of Madeira. Its streets are narrow, but well paved and sewered; the smaller houses, which are only one story high, are paved with round stones. The principal buildings, besides the three parish churches and as many monastic establishments, are the cathedral, 1514, in a mixture of styles, dedicated to the Virgin, and the neighbouring large episcopal palace. HARCOURT, *A Sketch of Madeira*, 8vo., London, 1851. 50. 96.

FUNDAMENT. An antiquated English adaptation of the Latin word *fundamentum*, which is explained as 'fotinge or fundament', and as 'grownde of byggyng' or 'fundament of a byldyng', in the *PROMPTORIUM PARVULORUM*, 1499; reprinted by WAY, 8vo., London, 1843, pp. 174 and 216.

FUNERAL or MORTUARY CHAPEL. A term which has been very loosely applied. Even VIOLETT LE DUC, *Dict.*, ii, 442-51, treats under one head 'chapelles isolées, des morts, et votives', although he considers the first and third class together as oratories, or as chapels whether sepulchral or votive; and discusses the peculiarities of the 'chapelle funéraire' or 'des morts', of which he forms two classes. One of these being open, was attached to a charnel-house or a public cemetery (as formerly at the charnier des Innocents at Paris), where on the jour de la fête des Morts (2 November) the clergy said mass: the other being closed, belonged, in his opinion, to a private cemetery, and served to shelter the clergy officiating at the mass before the benediction of the corpse, which was allowed, in some cases, to traverse the chapel immediately before transportation to the grave. Of the first sort is that at Avioth (Meuse); and of the second, that called the *chapelle de Ste. Croix* at the abbey of Montmajour, both illustrated in the pages mentioned. The illumination of such structures every night, as a sort of lantern to the burial-ground, and perhaps in some cases as a beacon to the passenger (whether to warn him away or to ask him to pray, or both, seems doubtful), appears to have been general in the early part of the middle ages. Such illuminated chapels might, by an unwarrantable extension of the signification of the words, be called 'chapelles ardentes': yet it must be evident that if those which were enclosed were not tombs, as GAILHABAUD seems to suggest, but were a sort of *morgue* for the reception of corpses until interment, they were really cemetery or funeral chapels, in the sense of chapels devoted to funerals, and would be 'chapelles ardentes' for the period during which religious services were being performed. **CEMETERY CHAPEL.**

It is remarkable also that GUENEBAULT, *Dict.*, s. v. *Chapelles funèbres ou ardentes*, notices the two or three chapels lighted by lamps over Christian tombs, as given in FANCIULLI, *De Lucernis*, etc., 4to., Rome, 1802, together with several *chapelles ardentes*, that is to say chapels prepared for the performance of the obsequies of distinguished personages by being made as black as possible and lighted artificially. The *chapelle ardente* (imitated at Chelsea Hospital on the occasion of the funeral of the duke of Wellington) may, however, be considered to be of three sorts; any room, chapel, or church, fitted up for that purpose; a catafalque or herse which is temporarily

placed in a church; and the imitation of that herse in metal or in stone, destined to remain as a monument, to be illuminated on certain occasions. To this last class GAILHABAUD, *Arch.*, iv, attributes a restoration from old metal work found in the church of Nonnberg.

The 'chapelle ardente', so explained, is thus confused with the **SEFULCHRAL CHAPELS** given in FANCIULLI, which ought to have been included in his list of 'chapelles sepulcrales' by GUENEBAULT, who, in that which he gives s. v. 'chapelle royale', has mixed several classes of chapels: and it is clear that GAILHABAUD, *Monumens*, describing the *tour d'Evrauld* at the nunnery of Fontevrauld (called in the text a 'chapelle funéraire', but on the plate a 'chapelle sepulcrale'), confesses his ignorance of the use of that structure, of the *octogone* at Montmorillon, and of the *monument de Ste. Claire* at Fuy (all illustrated in the same work), as well as of another at Chambon, given by him in *Arch.*, iii.

But if any construction specially prepared to receive a tomb is to be considered as a funeral or mortuary chapel, the term must be extended to monuments like the six chantries of the bishops in Winchester cathedral; to chapels like those of Henry V and Henry VII in Westminster abbey; and even to a church like that at Brou in France.

FUNERAL COLUMN (Fr. *colonne funèbre*). The name applied by some writers to a pillar raised instead of a cenotaph; or over a place of sepulture. **CIPPUS**; **MEMORIAL COLUMN**.

FUNFKIRCHEN. A well built and well paved city in Hungary. It was in the hands of the Turks 1543-1686. It chiefly consists of a large square and four streets proceeding to as many gates at the four cardinal points. The cathedral in a Pointed style, dedicated to S. Peter; the round church of the Jesuits, without pillars; the Greek church, and four others; two monastic establishments; a college; a gymnasium; the episcopal palace; the town-house; and two hospitals, are the chief buildings. 26. 50. 96.

FUNGUS. The name given to any of the flowerless plants with a cellular or filamentous body, often almost amorphous when fully grown, absorbing oxygen and exhaling carbonic acid, having a concentric mode of development, and propagating either by means of granules lodged in particular receptacles, or by a dissolution of the whole tissue. As the stem, also called the spawn or the thallus, of a mushroom is capable of reproducing the fungus, although the spheroidal head is supposed to be especially developed for the dispersion of the species, each filament of the stem seems to be a prolonged cell containing reproductive matter. When it is considered that fungi are so abundant that no estimate has been formed of the number of their genera and species, while the seeds are so minute as not to be visible unless collected into a mass of many thousands, it is difficult to conceive anything on our planet free from the presence of seeds. Indeed, SOWERBY, pl. 180, cites *Trichia polymorpha* as growing on a cindery substance in the outside gallery above the dome of S. Paul's cathedral; on putrifying bones, etc. The concentric growth of the filamentous spawn or stem is easily seen in damp and dark cellars, where the white flocculent matter, which begins to spread from a centre nearly equally in all directions, is the spawn of a fungus which may show a large extent without ever developing its fructification, for which a feeble amount of light is necessary.

It may be stated, in addition to what has been said s. v. **DRY ROT**, that it should be remembered, although fungus on timber is acknowledged by the architect as indicating the fact of dry rot, this term was formerly applied to a part of the plant: thus SOWERBY, *Figures*, etc., fol., London, 1797-1803, pl. 113, describing the head of the fungus which he calls *Boletus lachrymans*, says "the whole fructification often forms a centre from one to six inches in diameter, surrounded with an outer substance, tender, and pithy or cottony, of a pale brown";—"this pithy substance, without fructification, is often found by itself, and is very dry, whence the English name of

dry rot: yet as the fructification is seldom without drops of water resembling tears, the Latin name 'lachrymans' or weeping, has been given." But the same author, pl. 289, describing the *Boletus hybridus*, which "has many characters in common with the *B. lachrymans* and *B. medulla-panis*", says that it forms "more or less broad ramifications, often inosculating, of a cottony substance like the above mentioned, which are commonly known by the name of dry rot." This *B. hybridus* is called *Polyporus hybridus* by BERKELEY, *Outlines of British Fungology*, 8vo., London, 1860, who states that it is the cause in oak of dry rot, which arises in fir from *Merulius lachrymans*, the *B. lachrymans* of SOWERBY, who names *Antennaria cellaris* as the fungus that hangs in black powdery tufts about the brickwork of wine-cellars. It is wrong to suppose that dry rot consists exclusively of the spawn of *Merulius lachrymans* or of *Polyporus destructor*, or that they are the usual origin of it; on the contrary, one of the most rapidly spreading kinds is *Sporotrichum*, which about thirty years ago was active in the ships under repair at Sheerness; and *Dædalia quercina* has been greatly abused as a dry rot. 14.

BULLIARD, *Herbier de la France*, fol., Paris, 1784-1812; CORDA, *Icones*, fol., Prague, 1837-54; FRIES, *Systema Mycologicum*, 8vo., Lond., 1821-32; HOOKER, *British Flora*, 8vo., London, 1835; and HUSSEY, *Illustrations*, 4to., London, 1847-55; give assistance towards finding the particular fungus on any piece of timber.

FUNNEL. This word is used by FRANKLIN, *Smoky Chimnies*, 2nd edit., 8vo., London, 1787, who, p. 29, observes that "when there was but one chimney, its top might then be opened as a funnel, and perhaps, borrowing the form from the Venetians, it was then the flue of a chimney got that name"; and this idea, that 'funnel' meant 'flue', seems to be supported by NEVE, *Diet.*, 1703, who says that "the funnels of chimnies used to be carried through the roof"; by the BUILDER'S DICTIONARY, 1734, which notices the funnel twisted, or else narrower at bottom than at top; and by GWILT, *Encyc.*, who states s. v. that the funnel is the part, of a chimney, contained between the fireplace and the summit of the shaft. But the Act of Parliament 7 Anne, cap. 17, directs that no timber shall lie nearer than five inches to any chimney funnel or fireplace,—and all the funnels plastered or pargetted on the inside from the bottom to the top. The Act 4 George II, cap. 14, prescribes that no timbers whatsoever shall be laid or placed within nine inches of any funnel or flue of any chimney. The Act 12 George III, cap. 73, directs that all the funnels shall be plastered or pargetted on the inside of all parts thereof from the bottom to the top and outside to the ceiling of the upper story,—that the flue of every chimney on the outside of a party wall next to any vacant ground shall be lime-whited from the bottom to the roof,—and that no timber shall be nearer than five inches to any chimney funnel or fireplace. Hence it would appear that a funnel was not a flue: and it may be inferred that as DESAGULIERS's translation of GAUGER, *Fires Improved*, 24mo., London, 1715, describes the wings of a chimney as the sides of the funnel above the jambs; and as RICHARDSON, *New Collection*, fol., London, 1781, citing PALLADIO, mentions a pyramidal funnel over ancient fireplaces placed centrally in rooms, it may be inferred that GWILT, *Encyc.*, s. v. Chimney, had good authority when he defined 'funnel' as the cavity or hollow from the fireplace to the top of the room. The funnel, therefore, served to gather the smoke into the flue; and the cup of the funnel was in fact the CHIMNEY HOOD, now rarely seen except in the hood and funnel of a forge. It may be noticed that the words funnel and tunnel seem to have been used indiscriminately by some writers for the part above the breast and sides of a chimney.

FUNNEL, see FINIAL.

FURLONG. The eighth part of a modern mile, equal to 660 ft.; LEAGUE.

FURMER or FORMER, see FIRMER.

FURNITURE. A very long essay would be required, with almost innumerable illustrations, to give a full account of the changes which have occurred in the movable decorations and fittings of temples and dwellings. But inasmuch as the works on the principal styles of architecture generally include some sufficient notice of these details, it will be enough to mention WILKINSON, *Egypt*, etc.; SMITH, *Dict. Ant.*; RICH, *Illustr. Comp.*; VIOLETT LE DUC, *Mobilier*; TURNER and PARKER, *Domestic Arch.*; with the works of the artists named as decorators s. v. French Architecture, which give the phases of taste upon this point until the beginning of the present century; except the influence of Walpole, Adam, and Piranesi upon English furniture, as exhibited in CHIPPENDALE, *Cabinet-maker's Directory*, fol., London, 1762, and in SHERATON, *Cabinet-maker's Drawing-book*, 4to., London, 1793. Old furniture made of an imitation of ebony with brass or bronze ornaments, belongs either to their period or to that of Percier and Fontaine, whose influence in France was paralleled in England by that of Tatham. To him, perhaps more than to any other person, may be attributed the rise of the Anglo-Greek style which still prevails, as shewn in LONDON, *Encyclopædia of Cottage, etc., Arch.* A very large number of the specimens given in that publication may be taken as copies, more or less close, of articles designed by the late J. B. Papworth to exhibit a simplicity of which it was said in 1822 "the English is more chaste than the French-Greek, and has advanced so rapidly during the last ten years that the French have adopted much of it." Perhaps the best illustrations of his style are the interior views engraved in COXE, *Social Day*, 8vo., London, 1823. Contemporaneously with his style were an Egyptian fashion; HOPE's Greek 1807; an imitation of bronze (perhaps due to the discoveries at Pompeii) 1809; Elizabethan 1813; Gothic 1825; Tudor 1830; Gothic 1835; Elizabethan 1836; and Renaissance 1840. *Illustrations* issued 1849-50, pt. i; and 1858-59 (Chest).

The various sorts of wood used for furniture, most of which are mentioned in this work, will also be found noticed in the Illustrated Catalogue of the Exhibition of 1851, and in the Jurors' Reports, partly reprinted in the CIVIL ENGINEER JOURNAL, 1852, xv, 307-12.

FURNITURE. Although this term formerly meant, according to GWILT, *Encyc.*, the visible brasswork of locks, knobs to doors and window-shutters, and the like; from the change in materials it now signifies in specifications usually such portions of fastenings to fixtures or fittings as plates, scutcheons, knobs, and handles: the term, however, does not necessarily include many bright brass fastenings, such as latches, sash-fasteners, bolts, and espagnolettes. *Illustrations* are given s. v. Metal Work.

FURNUM, or FORNUS, or FURNUS. A Latin term meaning not only an oven, but a baker's shop, because it contained the oven: by an easy extension it was applied to a vapour bath as distinguished from the balneum or warm bath.

FURRING, see FIRING, and SHREADING.

FURSE'S CEMENT. A fusible mineral cement, which is said to have been invented at Hamburg, and to have been used on the Continent in extensive works of drainage and of fortification. It was exhibited, 1851, at London, as a waterproof artificial stone of rather dark colour and considerable hardness which, being non-absorbent and standing exposure well, was suitable as a cement for bricks; as a plastered lining to casemates, cells, cisterns, etc.; as the material for drains of large dimensions and for inverts to sewers; and (being cast in slabs so large as 8 ft. by 5 ft.) as flooring for churches or for damp places. The price was 6d. per square foot up to 2 ft. square: REPORTS of the Jurors, 8vo., London, 1851, p. 574.

FURTENBACH (JOSEPH), son of a *bauherr*, was born 30 December 1591 at Leutkirch, settled 1626 at Ulm, where he constructed many public buildings inclusive of the Brechhaus at the Gränz-thor 1634; the Brunnennwork in the Seelengraben

FURNITURE
CANDELABRA DESK TABLE

Fig. 3.



Fig. 4.
CONVENT ASSISI
in Marble

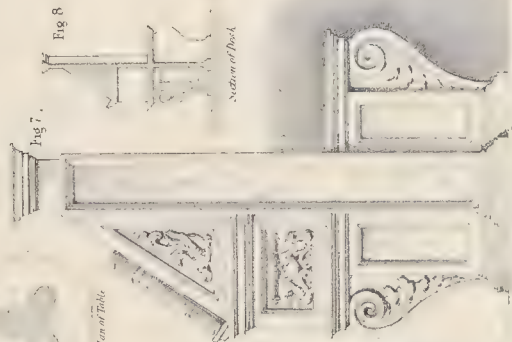


Fig. 7.

Head of Table

Bottom of Desk

Top of Pedestal

Fig. 2.



Fig. 2.
CANDLABRA
in Marble

Fig. 5.



Fig. 5.
CANDLABRA
in Marble

Fig. 6.



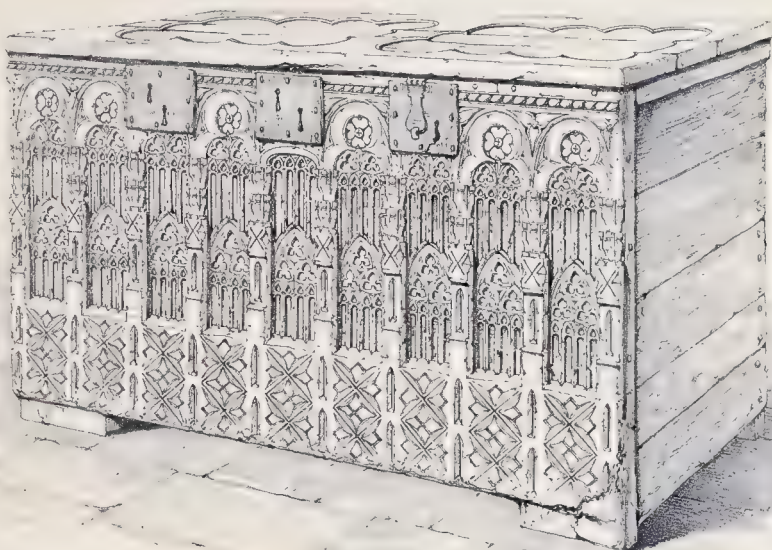
Fig. 6.
CANDLABRA
in Marble
Same Style as Fig. 5.

Fig. 1.



Fig. 1.
CANDLABRA
in Marble

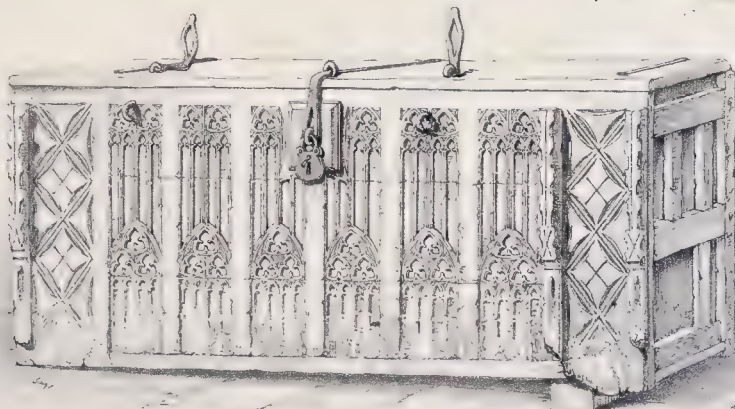




FAVERSHAM, Church, Kent.



SALTWOOD, Church, Kent.





1638; the Comödienhaus near the church of the SS. Trinity 1641; and the German school in the Eich; as well as a private house for himself, restored 1790 by J. K. Kienlin. A description of this house appeared 1641; an 'inventarium', of his collection, engraved on several plates by W. Rembold of Augsburg, was published 1660; and in 1651 his portrait was engraved by M. Kiesel. He produced at Ulm, among other works *Architectura Civilis*, 1628; *A. Navalis*, 1629; *A. Martialis*, 1630; *A. Universalis*, 1635; and at Augsburg *A. Recreationis*, 1640; *A. Privata*, 1641; *Feriarum Architectoria*, 1662; *Mannhafter Kunstspiegel*, 1663. He died 17 Jan. 1667 at Ulm, according to J. Rorh's *Leich Predigt*, published there in that year.

His son JOSEPH, born 1632, published amongst other works at Augsburg, *Mechanische Reissladen*, 1644; *Kirchengebäude*, 1649; *Teutsches Schulgebäude*, 1649; *Meyerkhofsgebäude*, 1649; *Gewerb und Stadtgebäude*, 1650; *Gottesackergebäude*, 1653; and *Garten-Palästleirgebäude*. He died 1655, consequently the *Hochzeit-haus Gebäude*, published 1662, was a posthumous production.

FUSAROLE. A term applied to a half-round member carved like a chaplet with oval beads, and generally placed under the echinus of the capitals in the Ionic, Doric, and Roman (*i. e.* Composite), orders. 1. 4.

FUSIBILITY. The property by which solid bodies pass into a liquid state by the addition of heat. The point of fusion is different in almost every substance considered, just as is the point of ebullition, or of the passage of liquids into the gaseous state; and it is also to be observed that until the whole of the substance under examination is completely fused, the temperature of the liquid cannot be raised, any more than it is possible to raise the temperature of a vapour so long as any liquid remains in it. In both cases, in fact, a large quantity of heat becomes latent. Some bodies are infusible at any temperature attainable in atmospheric air, but are capable of being fused by the combustion of certain gaseous mixtures, and all without exception can be reduced by electricity. Others, again, vaporize with such extreme rapidity that they hardly seem to have any permanent liquid state, as arsenic, for instance.

A great amount of uncertainty prevails with respect to the precise degrees of temperature of the less fusible bodies from the facts that the mercurial thermometer will not register above 600° Fahr., and that no trustworthy pyrometer has yet been invented. Wedgwood's pyrometer is the most satisfactory instrument of the kind hitherto used, but its very nature exposes it to such serious errors as to render its indications of little value. It consists of a brass scale divided into two hundred and forty parts, representing degrees; and the temperature of the body observed is ascertained by observing the expansion which clay cylinders of certain dimensions assume when they are raised to the same temperature. Wedgwood's pyrometer begins at 1077° Fahrenheit, and each subsequent degree is equal to an increase of 130 degrees. The following table of the fusion points of various substances is extracted from PECKET, *Traité de la Chaleur*, 4to., Paris, 1842. The degrees are on Fahrenheit's scale.

Mercury—below zero	- 28	Alloy, 2 lead, 3 tin, 5 bismuth	212
Ice	- 0	Sulphur	- 228
Tallow	- 92	Tin	- 410
Stearine	- 104 to 110	Bismuth	- 492
Phosphorus	- 136	Lead	- 500 to 612
Potassium	- 194	Zinc	- 680

The points of fusion of the following metals are reckoned in degrees of Wedgwood's pyrometer.

Copper	- 27 to 30	Nickel	- 160
Gold	- 32	Manganese	- 160
Steel	- 130	Molybdenum	- 170
Cobalt	- 130	Chromium	- 170
Iron	- 130	Tungsten	- 170

Silver melts at about 1800° Fahrenheit, or 22° Wedgwood, when pure; and at about 1890° when alloyed with one-tenth of gold.

G. R. B.

FUSORIUM. A Latin term for a drain, according to PALADIUS, i, 17 and 37.

FUSSITIUS, also written **SUFFITIUS**, see **FUFICIUS**.

FUST (Latin *fustis*, a club; It. *fusto*; Sp. *scapo*; Fr. *fût*; Ger. *sauleschaft*). A term formerly applied to the portion of the shaft of a column or trunk of a pilaster comprised between the base and the capital. It was also called the *naked*. The word was also used locally in Devonshire, and perhaps in some other counties, to signify the ridge (Fr. *faîte*) of a house. 1. 4.

FUTTEHPORE SECREE, also written **Futtipore Sikra**. The name of a place in Hindostan situated in the province of Agra, about twenty-four miles from the city of that name. The wall, with battlements and round towers built by the emperor Akbar, is still entire and encloses a space about six miles in circuit, which was never filled by the intended buildings, but is now occupied by a village amongst ruins that are said to be the most extensive in India. The edifices, built with the reddish and greyish sandstone of the ridge of hills on the back of which the site was chosen, date about 1569, when Akbar, in order to profit by the advice of the Sheikh Saleem of Cheest in Persia, who had established a hermitage here, proposed to reside on the same spot and began to cover the rock, or rather hill, with magnificent buildings for himself, his public establishments, and his courtiers. The following structures are the chief objects of notice. The tomb of Selim, also called Shah Selim Shurstre, who died 1584, is built of white marble, the walls being composed of immense slabs or rather screens of marble delicately carved and perforated, allowing a dim light to penetrate. This tomb stands in what is considered one of the finest mosques in the world, consisting of an area of 575 ft. square, surrounded by a high wall which backs a magnificent cloister completed 1578. On the west side it is broken by a gateway 60 ft. high and 40 ft. wide, pierced in a tower 120 ft. high and wide, standing on a flight of steps that rise 24 ft. The tower outside shows five sides of an octagon projecting from the wall with a width of about 80 ft. on each face. The tomb and gateway, shewn in SLEEMAN, *Rambles*, 8vo., London, 1844, ii, 68-74 and 247, are kept in repair by the government. Another tomb has several monuments of the family of Akbar, whose spacious palace, still tolerably entire, with his curious audience room having a central pillar about 7 ft. in diameter to support a throne raised 15 or 16 ft. and approached by a narrow stone bridge from each corner of the room, where his ministers had their places; his chess-board for living pieces, and his four-pillared canopy, reputed to have been the scene of his magical rites, still remain tolerably entire, as well as the small but richly ornamented dwelling of his minister Beenball. OLIPHANT, *Journey to Katmandu*, 12mo., London, 1852. The ORIENTAL ANNUAL, 8vo., 1839-40, gives a tower decorated with elephants' tusks; and a plate of the ruins.

FYLLETORY GUTTERS, 'to convey the water from the walls', is a term that occurs in an account of repairs 1532, cited in BAYLEY, *History of the Tower*, fol., London, 1821-5, part i, app. xxi; and which may have meant square or fillet gutters, in contradistinction to arris gutters; perhaps as shewn s. v. **EAVES CHANNEL**.

FYMERELL. An old manner of writing **FEMERALL**.

FYNIAL. An old manner of writing **FINIAL**.

FYNOL or **FYNOLY**. Old forms of the word **FINIAL**, which occur in the accounts 1394 for the wax herse of queen Anne; *GOUGH, Sep. Mons.*, fol., London, 1786-96, i, 170.



FULLER

ON BUILDING.

THOMAS FULLER, celebrated for his wit and fancy, and for the sound sense which he joined to uncommon powers of memory and judgment, was the son of the Rev. Thomas Fuller, rector of Aldwinckle, in Northamptonshire, where he was born in 1608. At twelve years of age, he left his father's tuition for that of Queen's College, Cambridge. In that University he became B.A. in 1625, and M.A. in 1628; but afterwards removed to Sidney College, where he obtained a fellowship in 1631; and nearly at the same time, the prebendary of Netherby, in the cathedral church of Salisbury.

In 1660, he was created D.D., and made chaplain extraordinary to the King, in recompense not only for his talents, but for an unshaken fidelity, in camp and garrison, to the royal cause; in despite of which, during the existence of the commonwealth, his services were gladly accepted as lecturer, at the Savoy; S. Clement's Lombard-Street, and S. Bride's. In 1648, the Earl of Carlisle procured him the rectory of Waltham Abbey; and in that year, some writers affirm, he published the very clever work, entitled "*The Holy State*", from which a chapter is extracted. He had been a constant employer of the press from the year 1631, having produced more than twenty works, still leaving his favourite book (*History of the Worthies of England*), to be published at his death, which occurred in 1661. He was buried in the church of Cranford, where his monument still remains on the north wall of the chancel.

In the preface to a new edition, with notes, of "*The Holy State*", by JAMES NICHOLLS (Lond. 1841), are the following passages as to the history of the work:—"It was," he says, "put to press at the close of 1640, but not published till 1642. It passed through three editions in the course of ten years; but is supposed to have run through five *bonâ-fide* impressions during the interregnum,—each of them consisting of a large number of copies. In a paragraph in one of the introductory chapters to his '*Appeal of Injured Innocence*', published in 1659, he alludes to 'some design in his stationer', in suffering this work 'still to stick in the title-page at the third edition'. The (nominally) fourth edition was published in 1663, soon after the decease of the author."

The chapter itself is valuable as expressing the ideas of the features considered to be essential in buildings, at the time when the Italian style of architecture was being introduced into England by the genius of Inigo Jones; although conveying, in a very happy manner, maxims derived from an observance of the edifices erected under the influence of the taste of Elizabeth and James I.

JOHN W. PAPWORTH.

OF BUILDING.

BOOK III. CHAPTER VII.

He that alters an old house is tied, as a translator, to the original, and is confined to the fancy of the first builder. Such a man were unwise to pluck down good old building, to erect (perchance) worse new. But those that raise a new house from the ground are blameworthy, if they make it not handsome; seeing to them method and confusion are both at a rate. In building we must respect situation, contrivance, receipt, strength, and beauty.

ARCH. PUB. SOC.

Of situation :—

MAXIM I.

Chiefly choose a wholesome air.—For air is a dish one feeds on every minute, and therefore it need be good. Wherefore, great men (who may build where they please, as poor men where they can), if herein they prefer their profit above their health, I refer them to their physicians to make them pay for it accordingly

s

MAXIM II.

Wood and water are two staple commodities, where they may be had.—The former, I confess, hath made so much iron, that it must now be bought with the more silver, and grows daily dearer. But it is as well pleasant as profitable, to see a house cased with trees, like that of Anchises in Troy:—¹

..... quamquam secreta parentis
Anchise domus arboribusque, oblecta recessit.²

The worst is, where a place is bald of wood, no art can make it a periwig. As for water, begin with Pindar's beginning ἀπ' αὐτὸν πρὶν ἵδω.³ The fort of Gog-Magog Hills, nigh Cambridge, is counted impregnable, but for want of water,—the mischief of many houses, where servants must bring the well on their shoulders.

MAXIM III.

Next, a pleasant prospect is to be respected.—A medley view, such as of water and land at Greenwich, best entertains the eyes, refreshing the wearied beholder with exchange of objects. Yet I know a more profitable prospect,—where the owner can only see his own land round about.

MAXIM IV.

A fair entrance, with an easy ascent, gives a great grace to a building.—Where the hall is a preferment out of the court, the parlour out of the hall; not, as in some old buildings, where the doors are so low, pigmies must stoop, and the rooms so high, that giants may stand upright.

But now we come to contrivance.

MAXIM V.

Let not thy common rooms be several, nor thy several rooms be common.—The hall, which is pandoeum,⁴ ought to lie open; and so ought passages and stairs, provided that the whole house be not spent in paths. Chambers and closets are to be private and retired.

MAXIM VI.

Light (God's eldest daughter!) is a principal beauty in a building.—Yet it shines not alike from all parts of heaven. An east window welcomes the infant beams of the sun, before they are of strength to do any harm, and is offensive to none but a sluggard. A south window, in summer, is a chimney with a fire in it, and needs the screen of a curtain. In a west window, in summer time, towards night, the sun grows low and over familiar, with more light than delight. A north window is best for butteries and cellars, where the beer will be sour for the sun's smiling on it. Thorough lights are best for rooms of entertainment, and windows on one side for dormitories. As for receipt:—

¹ VIRGILIÆneid, ii, 32.

² "And though remote my father's palace stood,
With shades surrounded, and a gloomy wood."

³ "Water, indeed, is the best."

⁴ Πανδοχεῖον, "A house for the reception of guests, an inn."

MAXIM VII.

A house had better be too little for a day, than too great for a year.—And it is easier borrowing of thy neighbour a brace of chambers for a night, than a bag of money for a twelve-month. It is vain, therefore, to proportion the receipt to an extraordinary occasion; as those who, by overbuilding their houses, have dilapidated their lands, and their states have been pressed to death under the weight of their house.

As for strength:—

MAXIM VIII.

Country houses must be substantives, able to stand of themselves.—Not, like city buildings, supported by their neighbours on either side. By "strength", we mean such as may resist weather and time, not invasion,—castles being out of date in this peaceable age. As for the making of moats round about, it is questionable whether the fogs be not more unhealthy than the fish brings profit, or the water defence.

Beauty remains behind, as the last to be regarded, because houses are made to be lived in, not looked on.

MAXIM IX.

Let not the front look asquint on a stranger, but accost him right at his entrance.—Uniformity, also, much pleaseth the eye; and it is observed, that freestone, like a fair complexion, soonest waxeth old, whilst brick keep her beauty longest.

MAXIM X.

Let the office-houses observe the due distance from the mansion-house.—Those are too familiar which presume to be of the same pile with it. The same may be said of stables and barns; without which, a house is like a city without works,—it can never hold out long.

MAXIM XI.

Gardens, also, are to attend in their place.—When God planted a garden eastward, He made to grow out of the ground every tree pleasant to the sight, and good for food (Gen. ii, 9). Sure, He knew better what was proper to a garden, than those who now-a-days therein only feed the eyes, and starve both taste and smell.

To conclude:—In building, rather believe any man, than an artificer in his own art, for matter of charges; not that they cannot—but will not—be faithful. Should they tell thee all the cost at the first, it would blast a young builder in the budding; and, therefore, they soothe thee up till it hath cost thee something to confute them. The spirit of building first possessed people after the flood, which then caused the confusion of languages, and since of the estate of many a man.

DICTIONARY OF ARCHITECTURE.

GABL

GABI (. . .) of Lille, restored or rebuilt 1714 the church of the Benedictine monastery (erected 1634 by J. de Breuck, jun.) at S. Guilain, six miles from Mons, while Dubressi rebuilt the rest of the structures there that had been blown up by accident 7 February 1656. 24. 98.

GABLÆ or GABII. A Latin city, about twelve miles from Rome, marked by the modern hamlet called Castiglione. The walls of the cella of a temple (supposed to have been dedicated either to Apollo or to Juno) are composed of rectangular blocks, about 4 ft. long and 2 ft. high, of the local stone without cement: the interior, which is nearly perfect, is about 50 ft. in length, and retains the ancient pavement of white mosaic; its sacrum is 6 ft. in depth. Some fragments of fluted columns formerly coated with stucco, and belonging to an Ionic order, are presumed to have been portions of the forum, discovered 1792; when also some seats of a theatre were exposed. These remnants of antiquity were illustrated in VISCONTI, *Monumenti Gabini*, 8vo., Rome, 1797. A few fragments of the town wall, and some vestiges of an aqueduct belonging to the time of Hadrian, are the only other remains at this place, which was noted for the quarries supplying the *lapis Gabinus*, a hard and compact variety of the volcanic tufo or peperino, considered by the Romans to be superior to the *lapis Albanus*, and extensively employed by them from the earliest times down to that of Nero. 23. 28.

GABIO (JEAN MICHEL DEL), born 15 September 1788 at Gabio in Piedmont, was a pupil of Vaudoyer and Despine. GOURRIER, *Choix d'édifices de France*, fol., Paris, 1825-50, who calls him Dalgabio, gives illustrations of some of the buildings designed by him as town architect at S. Etienne (Loire), where he was professor, in the public school of architecture, and erected the cemetery chapel, the abattoirs, and 1816 the office of the octroi with the corps de garde, etc., 1820 the exchange, 1821-8 the town-hall and municipal buildings costing 800,000 fr., and 1823 the prison and gendarmerie barrack costing 300,000 fr., as well as the corn market. The restoration of the churches of Ste. Marie and of S. Thomas were also executed by him, whose death is not recorded. 110.

GABLE (Fr. *pignon*; Ger. *giebel*). The upright work, closing the end of a pitched roof, from the tie-beam to the ridge; thus the tympanum of a pediment is a complete gable: but the use of the term has been extended to a wall, from the eaves to the ridge, where there is no tie-beam: in both cases it has been a common practice to insert a window, upon which the *Ecclesiologist Journal*, 1848, ix, 126, has the curious remark that "gable windows are surely out of place, except to light the space between a double roof, as in the case of a vault or a canted ceiling: an open timber roof does not require anything of the kind." In the account 1464-5 of 65s. for newly making one east *gabulum* at Giggleswick church, and

GABL

of 80s. for glazing the large window in that church, printed by the SURTEES SOCIETY, *Finchale Priory*, 8vo., Newcastle, 1837, p. 297, it has been hastily supposed that *gabulum* means the whole of the east wall of the chancel. VIOLETT LE DUC, *Dict.*, ii, 321, uses the word *pignon* for a wall with a gable as at the end of a transept, and s. v. *gable* defining that word as having originally meant the junction at their top of two inclined pieces of wood, gives a very ingenious suggestion of the manner in which *gable* became applied to a wall imitating the form of a pitched roof, but rising without any connection with a roof; the west end of the cathedral at Salisbury may be added to his illustrations of this falsity. Subsidiary roofs, when gabled, are amongst the chief means of producing a picturesque building. For example, a nave might have its roof intersected by dormer gables standing upon the main wall, and an aisle thus treated would resemble a series of gabled chapels, as in the case of the church at Scarborough, and of S. Giles at Oxford. In some few instances the towers of churches have been gabled in one of these ways, either with two gables forming a saddleback roof as at the church at Alberbury, co. Salop (*ARCHITECT Journal*, 1850, ii, 434); or with four gables as at the church at Sompting, co. Sussex, where the roof becomes a sort of spire; or with eight gables as to some octagonal spires and spirelets. Gabled bases to spires and spirelets are very common in the Rhine churches, and are often found in Italy. It would seem that gabled towers were not unusual in the military architecture of the early part of the middle ages. For one gable upon another it is only necessary to refer to BELL-GABLE, and VIOLETT LE DUC, *Dict.*, s. v. *clocher*.

Where the side of a roof ran against a wall, some mediæval builders outlined the slope of it and made such preparations for a gutter, that the side of slates or tiles or lead next to the wall rested upon a shelf about 6 ins. wide, which had a channel cut all down it; and instead of having a flashing of lead or a filleting either of plaster or of lime-and-hair, to prevent the rain from getting between the wall and the end of the roofing material, the water was allowed to find its way into the channel or gutter overlapped by the slates, etc. This system, of which an illustration is given by WILKINSON, *Practical Geology*, 8vo., London, 1845, p. 135, is illustrated by VIOLETT LE DUC, *Dict.*, s. v. *filet*; and for this purpose the shelf was either formed by carrying up the gable-wall about 6 ins. thicker than the part above the slates, etc., or by corbelling out a 6 in. channel; but the last named author also shows that this system was superseded by a course of stone projecting over the tiling, as a creasing, which has been called the roof water table, and frequently indicates the pitch of a former roof. It may be noticed that WILKINSON correctly calls the thicker wall under the slopes of the roof, the gable.

The crow-stepped gable, which is seen in houses of the fourteenth century at Bruges, was prevalent in Germany, Flanders, France, and Scotland; and a few examples of comparatively late date are to be found in England, where, since the sixteenth century, the roof has been commonly stopped by a wall with a stone or brick crest-table or fractable (*Detached Essays*, s. v. Brick Gable). But in this country, in France, and in the Low Countries, the gable with its projecting roof, vergeboards, and hipknob (to which modern innovations have added pendants at the eaves) have been common features which are well illustrated in PUGIN, *Gothic Gables*, 4to., London, 1831.

PARKER, *Domestic Architecture*, 8vo., London, 1851, ii, 342, observes that "it was during the fourteenth century that the custom of turning the gable end of the house towards the street began to be introduced", and "this custom was generally adopted in the fifteenth and sixteenth centuries, and discontinued again in the seventeenth": and he adds that "the gables turned to the street had the advantage of allowing more light to be received in all the stories"; which is evidently a mistake, and earlier specimens may be found on the continent of the domestic gable. The pediment was a mark of such dignity that Julius Caesar was the first Roman who had a FASTIGIUM to the front of his house: in the Middle Ages "avoir pignon sur rue" was equivalent to the reputation of being a rich man; and a gabled house paid double the tax of an eaved one, according to DE LA QUÉRIÈRE, *Essai sur les Girouettes*, etc., 8vo., Paris, 1846, p. 23.

Every gable of a church seems to have the completion of the coping of the gable properly made by a cross. Such gable-crosses, whether plain or diamond (and these are rare), or wheel, or floriated, or compound (*i. e.* with arms projecting beyond the wheel), vary in thickness from five to seven inches, and in diameter from two to three feet; a large number of specimens may be collected from the GLOSSARY; BRANDON, *Analysis*, 4to., Lond., 1847; the CAMBRIDGE CAMDEN SOCIETY, *Instrumenta Ecclesiastica*, fol., London, 1847, pl. 45-6; and several are given in the *Illustrations*, s. v. Cross. These crosses rise either from the junction of moldings belonging to a saddle-backed coping, or from a block cut into small gables where there is a flat or a crow-stepped coping. Where there is no cross, however, the termination is frequently made by three rolls, under which a small trefoil or other ornament is sometimes carved.

GABLET. This term is properly applied, in the case of each triangular face of the support to a gable-cross as above mentioned, in the *ECCLESIOLOGIST Journal*, 1844, v, 17; but it is used as "gablet or stone principal to a roof" in the report given in the *ARCHITECT Journal*, 1850, ii, 314-16, of the notice of the arches to carry purlins at Conway, Ightham, and Mayfield; in the latter case the arches, with a span of 40 ft., were still sound though the buttresses to them were dilapidated in parts.

It is also the name of the termination, instead of the usual bevelled set-off, to a buttress; this is generally finished with a roll, throated at each side, and has a small carved trefoil or other ornament in front.

GABRIEL (JACQUES), who married Marie de Lisle, a niece of F. Mansart, from whose designs he built the château de Choisy-sur-Seine, destroyed in the Revolution, held for twenty-six years the title of royal architect, and contracted 1685 for the erection of the pont-royal at Paris, from the design of J. H. Mansart. He died in the following year.

GABRIEL (JACQUES), son of the preceding, was born 6 April 1667 at Paris, and was a pupil of his cousin J. H. Mansart. He completed the pont-royal 1688 under the direction of F. Romain. In the preceding year he obtained the post of controller of royal buildings, although wanting five years of the legal age for that appointment; and 1689 went to Italy. The episcopal palace, which for some time was used as the hôtel de la préfecture, at Blois is attributed to a Gabriel, and

was probably erected soon after 1697, when the see was created. In 1699 he became a member of the Academy of Architecture, and 8 May 1700 an honorary member of the Academy of Sculpture and Painting. He designed 1704 the hôtel de Varengeville, afterwards Dalegre or Rupelmonde, in the rue S. Dominique (given in BLONDEL, *Arch. Franç.*, fol., Paris, 1752, i, 241, who says that he designed the château de Choisy). In 1709 he obtained letters of nobility, which were confirmed to him as royal architect in ordinary, at the time when such grants for several years previous were cancelled, in 1716, in which year he was appointed chief engineer of the ponts et chaussées. In 1718 he designed the maison Blouin, afterwards called the hôtel Feuquière, in the rue du faubourg S. Honoré (*Arch. Franç.*, iii, 146), which was altered about 1747 by Contant. After the great fire 22-29 December 1720 at Rennes, the new streets were laid out by an engineer, and designs for the new façades were furnished by Gabriel, to whom the *place Louis XIV* and *place Louis XV*, finished 1744, are attributed: they are shown in PATTE, *Monumens*, fol., Paris, 1767, p. 149, with a view of the tower which connects the cour du présidial with the hôtel de ville: it was probably for this work that he was made a chevalier of the order of S. Michel. Upon the death 1724 of Lassurance he continued, on the designs of Girardini, the palais Bourbon (*A. F.*, i, 265), or at least the internal decorations; and in 1728 received a brevet for an annual pension of two thousand livres for the erection 1725 of a bridge of eleven arches about 960 ft. long, 46 ft. wide, and 36 ft. high above low water (GENTLEMAN'S MAG., 1754, xxiv, 588) over the Loire at Blois; but this reward probably had reference also to a viaduct there about three miles in length, and other bridges, such as those at Beaumont-sur-Oise, Ste. Maxence, L'Isle-Adam, Pontoise, S. Maur, Charenton, Poissy, and la Guillotière at Lyon. PATTE, p. 138, also gives the *place* designed 1730 by Gabriel at Bordeaux. MILIZIA states that this architect designed the additions to the abbey at S. Denis.

On the death of Robert de Cotte, he was made 1735 the chief royal architect; 1736 director of the academy; and 1737 inspector-general of the royal works, holding these posts until his death 23 April 1742, according to the registers of the two academies, which have been consulted to correct LAMBERT, *Hist. Litt.*, 4to., Paris, 1751, iii, 133, who notices that Gabriel had the additional titles of conseiller du roi, and of seigneur de Bernay, de Mézières et autres lieux. This author avoids the common error (as in BLONDEL, *A. F.*, i, 205, corrected ii, 56) of attributing to this Gabriel the hôtel de Moras, afterwards de Biron, in the rue de Varennes: affirms that he designed the *place* at Nantes; the buildings in the Isle-Feydot; the town-hall, with the chapel and hall of the states at Dijon (but MAILLARD DE CHAMBURE, *Voy. Pitt.*, fol., Dijon, 1833, i, 43, simply ascribes to him 1743 the fine staircase leading to the salle d'ouverture des états); and the college de Navarre at Paris: and mentions as works which he left to be executed by his son, the great sewer of Paris; the *place* at Bordeaux; the abbey at Grandmont (Haute Vienne); the portal of the cathedral (another author says the whole cathedral) at la Rochelle; and the portal of the cathedral at Orleans, though LAMBERT, having seen more than twenty designs for the latter work by the grandson of J. H. Mansart, intimates that the author of the design was this young man, then one of the royal architects. 5.

GABRIEL (JACQUES ANGE), Sieur de Mézières, etc., born 1699, the son of the preceding, continued the works left unexecuted by his father, inclusive of the *place* partly formed by the bourse and the douane at Bordeaux, according to LAMBERT, and to BLONDEL, *Cours*, 8vo., Paris, 1771, i, 113, who seems to attribute to him the design of that work, which was finished 1743; of the *place Louis XV* at Rennes, which was completed 1744; and the *Handbook*, 1861, says that the design of the west front of the cathedral at Orleans was made 1764, and modified by his successor Paris. His age and his election 1728 into the Academy of Architecture, of which he became



1. $\mathcal{L}(\mathbf{X}, \mathbf{Y}) = \mathbb{E}[\ell(\mathbf{X}, \mathbf{Y})]$

181. 12. 21. 1900. 3. 4. 1801. 10. 11. 1900. 1801. 10. 11. 1900.

A Fable in a.d.v. - CINC



director 1743, renders it probable that he assisted his father for many years. This Gabriel, however, was reputed one of the greatest French architects, and the best of those who practised in France during the eighteenth century. He was chief royal architect when elected 26 May 1742 an honorary member of the Academy of Sculpture and Painting. In 1750 he commenced the école militaire and the champ de Mars. In 1753 the twenty-eight competition designs for the *place Louis XV* at Paris were placed in his hands to make the best he could of them, and the result, originally suggested by Servandoni and by Lassurance was the plan of the *place de la Concorde* nearly as at present with the two ranges of buildings (each about 290 ft. long, and completed 1772) that are separated by the rue Royale; this work is illustrated by PATTE, *Monumens*, fol., Paris, 1767, p. 121, who in the *Mémoires*, 4to., Paris, 1769, p. 278, shows the construction of the entablature, ceiling, and roof of these colonnades. In 1753 also he commenced at Versailles the theatre which, although often delayed, was opened 1 June 1770; it is 158 ft. long, 65 ft. 6 ins. wide, and 55 ft. high. At Versailles (for which palace he prepared a new plan) he was employed to reduce the size of the apartments, for instance the escalier des ambassadeurs and the galerie de Mignard were divided, but the ceiling of the salon d'Hercule and the pavilion at the end of the north wing built by Le Vau, were his work, as was also the "petit Trianon", of which a plan is given in LABORDE, *Versailles*, 8vo., Paris, 1839, p. 502. The château at Compiègne, and the enlargement of that at Choisy, were also his work, as well as the continuation of the north and west façades to the court of the Louvre, where he appears to have been at first employed 1737-57 to restore the colonnade of Perrault (the stones in the soffits having split and splintered), and afterwards to finish the attic (begun by Perrault) to the face of the courtyard behind that colonnade: QUATREMÈRE, *Dict.*, s. n., discusses this subject, and enters into a criticism of the works by this Gabriel, who died 4 January 1782, aged 83.

A younger Gabriel is noticed in the registers of the Academy of Architecture, as having been controller of the royal edifices, elected a member 1763, and deceased 1781. 45.

GABRIELLI (il Capitano ANTONIO), born 1625 at Città del Castello, studied at Venice. In his native city he built the theatre opened 1666, and with his pupil N. Barbioni designed the church of Sta. Maria di Belvedere, 1669-84, that was nearly ruined by an earthquake 1789. F. Albizzini was another of his pupils. The year of his death is not given by MANCINI, *Istruzione*, 8vo., Perugia, 1832, ii, 173, who states that he was alive in 1678.

GABRIELLI (GABRIELE DI), born 1671 at Roveredo, went to Vienna, where he prepared the plans of several of the Lichtenstein palaces; entered the services of the margraves of Ansbach and of Baireuth as oberbaudirektor, and 1730 held the same employment from the prince-bishop at Eichstadt, where he built among other works the new wing of the 'Residenz'; and died 1740. 68.

GABULUM, see GABLE.

GAD. A wedge, ingot, or small bar of steel, according to BARETTI, *Dict.*, 1778, and CONNELLY, *Dict.*, 1798: they thus explain the gift made by "Sir William de Cottingham, vicar in the cathedral church of York, who, by will proved 4th Feb. 1347, bequeathed to the fabric of the said church twenty-four long gads of Spanish iron; TORRE, *MSS. York Minster*, fol. 159, from Regist. O y. fol. 4, now lost", as stated in BROWNE, *York Cath.*, 4to., York, 1838-47, 126.

GADARA. The ancient name of a town now represented by the village called Om Keiss on the east side of the valley of the Jordan. The foundations of a whole line of houses, and the remains of a row of columns which lined each side of the main street, broken columns and capitals, portions of a Roman bath, and a number of sarcophagi, indicate the ruins of stately private and public buildings, to which may be added a destroyed theatre to the north, and another tolerably preserved and very

handsome to the west, of the town. In the necropolis, to the north of Gadara, are subterranean sepulchres with massive stone doors that are still movable. IRBY, *Travels*, 8vo., Lond., 1823, p. 297; LINDSAY, *Letters*, 8vo., Lond., 1838, ii, 97. 59.

GADDI (TADDEO), born about 1297, practised at Florence, where he began 29 July 1337 to underpin and ease with ornamental stonework the brick piers of the Or S. Michele before his addition of the two upper stories: the chapel round the celebrated picture was the work 1348-58 of A. Orcagna. After the death 1336 of Giotto, this Gaddi continued from that artist's design (suppressing the spire which was to have been about 100 ft. in height) the campanile to the duomo. He died 1352 aged 55 years, according to VASARI, but RUMOHRE, *Italienische Forschungen*, 8vo., Berlin, 1831, ii, 81, shows that he was alive 20 August 1366 according to the archives of the works at the duomo. MARCHESI says that BALDINUCCI may err in stating that Taddeo rebuilt 1333-45 the ponte Vecchio. VASARI and BALDINUCCI affirm that Taddeo repaired and strengthened 1346 the ponte alla Trinità, but BOTTARI attributes this work to Brachetti. The *Guide Book* of 1841, thinks that the ponte alla Carraja was restored 1334 by Brachetti; but that of 1842 says that it was rebuilt 1333 by Taddeo, who is said to have made additions (perhaps the machicolations only) to the portion called the dogana of the palazzo de' Signori, now termed the palazzo Vecchio, but there is much confusion in the history of this building. MILIZIA states that the palazzo was altered by Taddeo, who repaired the castle of S. Gregorio.

GADDI (AGNOLO), who is supposed to have been the son of Taddeo, and who also practised at Florence, enlarged and altered (adding the battlements to it) the palazzo degli Anziani or del Podestà, which was afterwards the residence of the Bargello or chief of the police, and has recently been known as the palazzo del Giustizia, at Florence. He also erected 1372 the church of Sta. Maria Annunziata d' Orbatello in that city. FANTOZZI, *Nuova Guida*, 1842, pp. 246, 389.

GADIO or GAZZO (BARTOLOMEO), born at Gadio near Cremona, was commissioned 1463 to design and erect, as a memorial of the marriage of the grand duke, a church which was given to the Vallombrosani, but which is now called S. Sigismondo, in that city. 57. 68.

GADROON, see GODROON.

GADYER (PIERRE), was master mason, from 1528 till 1531, the period of his death, of the château called Madrid near Paris, which was destroyed at the end of the eighteenth century: and the merit of its design may be due to him or to Girolamo della Robbia, who executed the faience decorations; LABORDE, *Le Château*, 8vo., Paris, 1855, pp. 25-31. A view of it is given by BORDIER et CHARTON, *Histoire*, 8vo., Paris, 1861, ii, 128; and illustrations in VIOLET LE DUC, *Entretiens sur l'Arch.*, 8vo., Paris, 1860-1, i, 352, pl. xv, xvi.

GAERTNER (JOHANN ANDREAS), born 1743 at Dresden, seems to have been of the same family as JOHANN, an architect of repute in the early part of the eighteenth century in Germany. Though educated as a military engineer, he on going to Poland was employed by count Minitschek to design various buildings on his estate. Having visited Vienna, and Berlin, he went to Paris, where he remained nine years, acting as clerk of the works at Versailles, but returned to Germany to finish the residenz or electoral palace at Coblenz, where he held the rank of colonel of artillery. Taking similar service under the prince-bishop of Würzburg, he erected several buildings in that city and its neighbourhood, amongst them the theatre; and restored the church of S. Michael; and also restored count Schönborn's château at Gaibach. He removed to Munich 1804, being appointed hofbauintendent, and made numerous designs some of which were executed; but his style being superseded by a new fashion, he destroyed all his drawings, and died 1826, in the eighty-third year of his age, leaving a son, the subject of the following notice. 14.

GAERTNER (FRIEDRICH VON), born at Coblenz in 1793,

was educated at Munich, and in 1809 entered the Academy of Arts to study painting and architecture under H. K. von Fischer. In 1812 he went to Paris, entered the Academy, and studied under Percier. During 1814-18 he travelled in Italy and Sicily, and on his return published *Ansichten der um meisten erhaltenen Monumente Siciliens*, fol., Munich, 1819, in which year he visited Holland and England, where he would have resided, but returned to Bavaria on being appointed professor of architecture in the Academy at Munich. Undertaking 1822 the direction of the artistic details in the manufactory of porcelain, he introduced great changes in the character of the works produced there, and revived the processes of glass-painting: his manner is shewn in his publications *Römische Bauverzierungen*, 1824, and *Auswahl von Vasen*, 1825. At Munich he designed 1828 the façade of the porcelain establishment; 1829 the Ludwigs-kirche; and 1832 the Bibliothek or public library and record office, 520 ft. long and 85 ft. high; restored 1833 the Isar-thor; commenced 1834 the Blindeninstitut; 1835 the new buildings of the university and the opposite seminary called the Georgianium; 1836 the Erziehungs-institut, and the Damenstifts-gebäude; 1837 the church of the hospital of the Sisters of Charity; 1838 the Salz-amt; 1841 the Feldherrnhalle; 1843 the Wittelsbach palace; 1844 the arcades of the cemetery; and 1844-6 the queen's villa near the Siegesthor, as well as the triumphal arch, so called, in the Ludwigstrasse, which was finished by Metzger.

He also designed 1837 the pump room at Kissingen; 1842 the Befreiungshalle at Kehlheim, a great monument in the form of a rotunda to commemorate the liberation of Germany, finished by von Klenze; 1842 the Pompeian house at Aschaffenburg, an effort to collect a series of examples of styles; 1842 a villa at Ludwigsanholte in the Rheinpfalz; 1844 two fountains in the University square, Munich; and a small Protestant church at Kissingen. The preceding list does not contain his works of secondary importance, such as the restorations of portions of the cathedrals 1833 at Ratisbon and Bamberg, and 1845 at Speier; or the private buildings, such as the Baierischer-hof hotel. He accompanied his patron, king Ludwig I, to Greece in 1836, where he designed the palace for king Otho, and reopened the quarries of Pentelic marble. On his return he was appointed oberbaurath; received the order of civil merit; and resigned his professorship to his pupil Voit; in 1841 he succeeded Cornelius as director of the Academy of Arts, and introduced many reforms; in 1845 he succeeded von Klenze as the king's special architect. Besides receiving decorations from the kings of Greece and Belgium, he was in the list of Hon. and Corr. Members of the Royal Inst. Brit. Architects. He was made a commander of the Bavarian order 1 January 1847, in which year he died 22 April, aged 55 years, according to the ALLG. BAUZEITUNG, 1848, p. 148, which gives his portrait with a memoir; and pl. 212-5, illustrates the façades of the fort at Germersheim.

Much of the fame of Munich for interior decoration, also, is due to Gärtner, who published, besides the works above named, *Sammlung der Entwürfe ausgeführter Gebäude*, 35 pl., fol., Munich, 1844-7, containing the Ludwigs-kirche and the Bibliothek. BARTELS, with others, published *Architek. Entwürfe zu Pracht-und-Civil Gebäuden; ausgearbeitet nach motiven des Oberb. F. von G.*, fol., Munich, 1846. RACZYNSKI, *Hist. de l'Art Moderne*, 4to., Paris, 1836, ii, 438.

GAETA (Lat. Caieta). An irregularly but neatly built city in the province of Terra di Lavoro in Italy. The streets are narrow and steep, but are well paved. It was one of the favourite resorts of the Romans, who have left vestiges of a temple said to have been dedicated to Serapis, and of an aqueduct, with the cellular tomb, of Lucius Munatius Plancus the founder of Lyons, erected about 10 B.C. and now called the torre d'Orlando, which remains in excellent preservation. The neck of land between Formia and Caieta was occupied by villas, and a ruin called il Faustignano is supposed to have belonged to

Antoninus Pius, and near Castellone is a tomb called the torre di Cicerone like that above named. Gaeta became, under the Normans, one of the most considerable cities in the Neapolitan dominions. The cathedral, which has been lately rebuilt, is dedicated to the Assumption of the Virgin, and has a fine tower. The episcopal palace near it, was rebuilt 1818-27. There are also the church of the SS. Trinità, a monastery, two hospitals, and a founding hospital.

23. 28. 50. 96.

GAGE, see GAUGE.

GAIN. A word used by carpenters to signify the bevelled shoulder, made for the purpose of giving additional resistance to the tenon below it, where the end of a binding joist is framed into a girder. It seems to be derived from the following term.

1.

GAINE (It. *guaina*). A French word, formerly adopted in the English language where it still lingers, meaning the lower part or shaft of a terminal: the Fr. *gaine de scabillon* means the dado of a pedestal.

GAINSBOROUGH (RICHARD DE), see GAYNESBRO.

GAINZA (MARTIN DE), a native of Navarre, was aparejador 1530 to the cathedral at Seville under D. de Rianno, whom he succeeded as maestro-mayor 16 April 1535, and whose designs for the chapter-house and two sacristies were executed by Gainza, whose design, made 1540, for a complete monastery of Hieronymites at Bornos is still, perhaps, in existence. As the (probably Gothic) designs made by H. de Egas and J. de Alava for the capilla real at the above named cathedral, were not approved by the chapter, that body, after unsuccessfully attempting to procure an architect from Flanders or from Italy, ordered 7 September 1541 that Gainza should make a design and model. These he did not present complete until 1551, when they were approved by a committee of four architects, and the work was immediately commenced; but Gainza died 1553, and it was continued by F. Ruiz. The delay of ten years in the production of this design was caused by his occupation, in competition with three other leading architects, on the design of the hospital de la Sangre at the same city, which, after some corrections by a committee of six others, was put in execution 1546 by Gainza, who laid the first stone 12 March. After his death this work was continued by M. de Valiarren, and after 1558 by F. Ruiz.

66.

GAISO (GIOVANNI DEL) restored, probably about 1752-3, from the design of D. Vaccaro, the church of the nunnery of Sta. Chiara at Naples, where he also restored 1737 the Benedictine church of SS. Severino and Sossio, that had been built 1490-1520.

95.

GALABSHE in Egypt, see KALABSHEH.

GALAN (PEDRO), one of the best architects of his time and place, died 19 October 1613 at Madrid.

66.

GALATA, see CONSTANTINOPLE.

GALAVVERNA (IL), see MALAGOLA (CRISTOFORO).

GALENA. The ore of the sulphuret of lead is commonly known by the name of galena. It is the most common form of ore worked for the preparation of the pig and milled lead of commerce, on account of the ease with which it is converted; sometimes it is known by the name of 'lead glance'. The galena occurs usually in a crystalline form, in cubes or in cubo-octohedrons; sometimes it is found in a lamellar state; and more rarely in the polished granular state known as 'slicken-sides'. Its colour is of a bluish grey, like that of lead, with considerable powers of reflecting light. Galena almost always contains a small quantity of the sulphuret of antimony, or of the sulphuret of silver; and sometimes also small quantities of pure metallic silver: the usual proportion of silver present is about 5 in 1000. Selenium is occasionally associated with galena, and in much rarer instances it contains arsenic. Before the blow-pipe galena decrepitates, melts, and emits a sulphurous smell.

G. R. B.

GALILEE. This word has been sometimes supposed to designate the nave of a church, and still more frequently

it has been asserted that when a female applied to see a monk, the answer was given in the Scriptural words "He goeth before you into Galilee, there shall you see him", the porch of the church being at the same time indicated to her. It would therefore appear to have been the term for a room near the entrance of the church, where females were allowed to see the monks to whom they were related, or to hear divine service; where corpses were laid previous to interment; and where the monks collected in returning from processions. The term is chiefly applied to such places in England, as the lobby or entrance into the cathedral at Ely, and at Durham (serving as the Consistory Court), being in both cases in front of the west end of the church; and as the porch on the west side of the south end of the great transept of the cathedral at Lincoln.

In the Liberate Roll, July 20, 34 Henry III, a stone wall is ordered to be built 10 ft. high from the door of the king's hall at Windsor to the galilee of the new chapel—and to make a wooden barrier round the outer part of the same galilee, so that horses cannot reach the same galilee; TURNER, *Dom. Arch.*, i, 223. SMITH, *Antiq. of Westm.*, 4to., London, 1807, 70-1, shows by the account of Martin de Ixning, that the galilee begun by Edward III at the west front of S. Stephen's chapel, was being covered 1347; it is shewn in SOCIETY OF ANTIQUARIES, *Vet. Mon.*, fol., London, 1842, pl. 26.

The name is also given to the library, as it is commonly called, in the centre arch of the front of the cathedral at Peterborough; to the projection from the west front of the church of S. Mary at Melton Mowbray in Leicestershire (which exhibits some peculiarities); to that at the church of S. Mary at Snettisham in Norfolk (COTMAN, *Etchings*, fol., London, 1818, pl. 45); and one is supposed from foundations discovered 1853 to have existed at the west end of the church at Fountains abbey, Yorkshire. 80.

GALLILEI (ALESSANDRO), born 1691, accompanied some British (?) noblemen to England, where he remained for seven years. On his return to Florence he was made superintendent of the ducal buildings in Tuscany by the dukes Cosmo III and Giovanni Gastone: but his abilities were only shewn at Rome, where for Clement XII (1730-40) he designed the front of the church of S. Giovanni de' Fiorentini, and of the church of S. Giovanni Laterano, with the very splendid capella Corsini in the last named basilica, all severely criticized by MILIZIA, who states that he died 1737. 68.

GALL. The secreted liquor of the liver, or in other words the bile, of animals. In a prepared state it is useful to the draughtsman in water colours, as neutralising any fatty matter in or on the materials employed by him.

GALLEGO (JUAN) of Segovia is considered to have been the architect of the Hieronymite monastery of Sta. Maria del Parral in the vicinity of that city, after having carefully arranged for the supply of water, as he was *maestro* in 1459. He is supposed to have died before 1472, when a contract was made for the completion in three years of the capella mayor of the church; and 1494 the *tribuna del coro*, being considered too low, was pulled down and rebuilt of a greater height by J. de Ruesga. 66.

GALLERY (in old documents gallerie and gallorie). This word is derived from the Lat. (of the ninth century) *galeria*, which in the fifteenth century was explained as *ambulacrum*, and *corredor domus*. It is remarkable that although L. DA VINCI had written 'galleries are built to receive pictures and statues', SAUVAIL, *Histoire*, fol., Paris, 1724, iii, 49, giving a list of the galleries or long rooms then famous in that city, says that such apartments were not known to the ancients, and had been so little used by the Italians that he could only instance those at the palaces of the Vatican, Monte Cavallo, and the Farnese family, at Rome. BLONDEL, *Cours*, 8vo., Paris, 1771, iv, 262, explains the term as formerly meaning a *portique*, i. e., a covered arcaded external means of communication round a building; applies the term to the dormitory of a monastic estab-

lishment; and notices that chimneys were not common in the old galleries. Under that name, in his *Arch. Franç.*, fol., Paris, 1752, i, 36, iii, 75, and iv, 19, he mentions seven magnificently decorated internal apartments, with lengths varying from five and a half to eight and a half times the breadths.

The term has obtained a much wider application:—

A passage, covered or uncovered, above a main roof; ALURE. French authors use *galerie* as the Italian writers use *ballatoio*, for a great balustrade or pierced parapet, as well as for such a passage.

A passage, covered or uncovered, against the outside of a main wall. BALCONY; VERANDAH. The term *galerie* is used for the alley of a cloister throughout VIOLETT LE DUC, *Dict.*, s. v. *cloître*.

A balcony supported on brackets, piers, or pillars, along the inside of a main wall or partition, such as the landings of staircases, and as the upper seats in churches (called scaffolds in 1638), theatres, halls, etc. LOFT; AMPHITHEATRE.

BINGHAM, *Origines*, 8vo., Lond., 1840, ii, 415, says that in the Greek churches the inner parts of the galleries were sometimes divided into little cells—occupied as lodgings by married people.

An internal passage in a large building, where it is sometimes a mere CORRIDOR, sometimes made into a conservatory or a shooting-gallery, at others a long apartment suitable for exercise, etc. Some noted examples of this kind are given in the following list, those marked * being no longer in existence.

| | Long.
ft. ins. | Wide.
ft. ins. | High
ft. ins. |
|---------------------------------|-------------------|-------------------------------|------------------|
| Hardwick, Derbyshire - | 166 4 | 22 5 | 26 0 |
| Hatfield House, Hertfordshire - | 163 6 | 19 6 | 15 0 |
| *Copped or Copt Hall, Essex - | 168 0 | 22 0 | 22 0 |
| Blickling Hall, Norfolk - | 127 0 | 21 0 | — |
| *Heslington Hall, Yorkshire - | 108 0 | — | — |
| *Bolsover, Derbyshire - | 220 0 | — | lofty |
| Aston Hall, Warwickshire - | 136 0 | 18 0 | 16 0 |
| Charlton, Wiltshire - | 124 0 | — | — |
| *Theobalds, Hertfordshire - { | 144 0 | 12 0 | — |
| or { | 123 0 | 21 0 | — |
| Belvoir Castle, Derbyshire - | 131 0 | { 17 8
35 8 at bay window. | { 15 2
— |
| Sutton-place, Surrey - | 141 6 | 20 9 | 14 4 |
| Montacute, Somersetshire - | 129 0 | 21 0 | — |
| Surrenden, Kent - | 120 0 | — | — |
| Haddon Hall, Derbyshire - | 110 0 | 17 0 | 17 0 |
| Andley End, Essex - | 226 0 | 34 0 | 22 0 |
| *Richmond Palace, Surrey - | 200 0 | above an open gallery. | — |
| *Harlaxton, Lincolnshire - | 100 0 | 14 0 | 11 0 |
| Longleat, Wiltshire - | 160 0 | — | — |
| Parham, Sussex - | 157 3 | 18 0 | 13 0 |
| *Amptill, Bedfordshire - | 245 0 | — | — |

The employment of such apartments as places for exhibiting treasures, has at last not only caused the term to be improperly given to a large room, as in the case of each saloon in the British Museum, but actually to an edifice containing suites of large rooms, as in the instance of the National Gallery; and has consequently become the title of a shop for the sale of prints, etc. BANQUETING ROOM; PICTURE GALLERY; SCULPTURE GALLERY; EXHIBITION ROOM; HALL; LIBRARY; MUSEUM; SALOON; each of these is more or less commonly called a GALLERY.

Upon the continent the Fr. *galerie* is commonly applied, as well as *passage*, to a sort of BAZAAR or market for delicate articles, like the English ARCADE. As a particular example, notice may be taken of the *galeries du Commerce or de l'Industrie*, built 1838, in the boulevard Bonne Nouvelle, by Grisart and Frœlicher, and illustrated in NORMAND, *Paris moderne*, 4to., Paris, 1845, ii, pl. 4-6.

The avenue to a tumulus, or rather to the chamber or chambers serving for the nucleus of the barrow; as noticed in the ARCHÆOLOGIA, 1853, xxxv, by LUKIS, *Observations*, p. 253. Such a gallery is termed in France *allée couverte*.

The flying passage which bridges over the space between the towers of certain churches, as at S. Elizabeth at Marburg,

at Boppart, and one over another at S. Dionysius at Esslingen; or crosses a moat; or connects the sides of a large room, as in the audience chamber of Akbar at FUTEHPORE-SECREE.

The gallery in front of churches took its origin from the necessity of accommodating the choir, who sang 'Laus, Gloria', etc., when the procession on Palm Sunday returned from carrying the sacrament to the cemetery. Frequently windows were grouped closely for this purpose, and this may have been the design of the huge west arch at Tewkesbury. In bad weather the ceremonial was held before the altar of the Cross, under the choir-screen; and this custom may have led to the construction of minstrel galleries at Winchester, Exeter, and Malmesbury. JUBE. Galleries are found at the west end of the nave at Le Mans and Jumièges; in the north transept and in the north nave aisle at Winchester; in both transepts at Bocheville; in the south transept at Westminster (*Illustrations*, 1859), Hexham, and Cerisy; and like a small arcade at Elgin: WALCOTT, *Church, etc., Arrangement*, 8vo., Lond., 1861. There is an eastern gallery dating in the twelfth century remaining at Compton in Surrey, and there are traces of similar galleries at the east end of several other Norman churches, as at Darent in Kent: in churches, also, of the same century, in some parts of France, especially in Périgord, a western stone gallery is the rule rather than the exception in small parish churches; GENTLEMAN'S MAGAZINE, April 1862. Double and triple galleries in the churches between Bayonne and S. Sebastian, are described in the *ECCELSIOLOGIST Journal*, xiv, 1853, p. 172-7, which also notices the prevalence of single western galleries in Spain. 17. 19. 80.

GALLESE. A city near Viterbo in Italy. It is little known, although it contains a cathedral, dedicated to the Virgin, and renewed 1780 by Camporesi, as well as a ducal palace by Vignola, three monasteries, and a nunnery. 96.

GALLET, GALLEY, GALLOT, GELLET, and GULLET (Fr. *écaille*). These words, perhaps derived from the Fr. *gallette*, a small flat cake, are applied to a small chip of stone. Thus LAXTON, *Price Book*, says "Galleting the joints of Kentish ragstone work externally, extra per foot super. 1½d."; but the *ECCELSIOLOGIST Journal*, 1846, vi, 45, remarks that the term "Garretting is employed to express the act of filling up with shivers or thin splinters of flint, the mortar joints in walls built of flint."

GALLEY TILE, see DUTCH TILE.

GALLI. The family name of a race of architects whose designs, especially for the specimens of fictitious architecture called *prospettive*, for the scenery in theatres, and for the decorations of gardens, etc., on festive occasions, may be found in almost every collection of drawings produced during the seventeenth and eighteenth centuries. Such drawings are usually marked BIBIENA, because the progenitor of the family, the painter Giovanni Maria Galli of Castel Bibiena in Tuscany, was called Bibiena at Bologna to distinguish him from another Galli who was his fellow-pupil in the school of the Albani; and the posterity in question was chiefly known by that name, which is frequently written Bibbiena. This Giovanni Maria had two sons, Ferdinando and Francesco; the elder brother, who is called *il Bibiena* by Bolognese writers, and his descendants will be first noticed.

GALLI BIBIENA (FERDINANDO), born at Bologna 18 August 1657, designed the villa di Colorno and regulated the buildings at Parma and Piacenza for the duke Ranuccio Farnese II of Parma (d. 1694), and his son Francesco, and was employed as director of the fêtes at Barcelona on the marriage 1 August 1708 of Charles III of Spain in that city. He returned to Parma, where he built a theatre supplying the scenery to it; and published *L'Architettura civile preparata sulla geometria e ridotta alle prospettive*, with 72 plates, fol., Parma, 1711. On succeeding 1711 to the empire, Charles VI took Ferdinando with him to Vienna, where he conducted the works for the state festivities, especially the great hall or theatre

(which has been illustrated in six engravings with his portrait by Caccioli) for the coronation, and the illuminations and fireworks on the water of the villa called la Favorita, on the occasion of the birth, 1716, of the arch-duke Leopold. In consequence of impaired eyesight, Ferdinando returned to Italy, where he published, under the signature Accademico Clementino, a reply to the *Economia delle fabbriche contra i pittori d'architettura*, 1721; and *Direzioni a' Giovani*, with *Direzioni della prospettiva teorica*, 8vo., Bologna, 1725-31, and Parma, 1731, and Bologna, 1745-53, which profess to be a revision of the *A. civile* of 1711. He became blind, and died 1743 in that city, leaving three of his sons, Giuseppe, Alessandro, and Antonio, in practice; his portrait is given in ZANOTTI, *Storia*, 4to., Bologna, 1739, ii, 201. He was a member of the Clementine Academy, and painted *prospettive* at Bologna, where the *sala grande* of the palazzo Ranuzzi now Baciocchi is attributed to him by BIANCONI *Guida*, 12mo., Bologna, 1826, though other writers consider it the work of his son Antonio. A. Cugini was his pupil.

GALLI BIBIENA (GIUSEPPE), born 5 Jan. 1696 at Parma, was also celebrated for theatrical decorations. He about 1716-7 succeeded his father in the service of Charles VI, for whom he conducted the works for the coronation 1723 at Prague including an amphitheatre holding 8,000 persons, the festivities 1732 at Linz, and the marriage 1736 of Maria Theresa. He designed some large buildings in Silesia, and published some plates according to ZANOTTI, *Storia*, 4to., Bologna, 1739, ii, 237, who gives his portrait. To him, therefore, may be attributed the designs engraved by C. dell'Acqua with the title *Sei disegni che rappresentano un cortile regio, delizie reali, piazza reale, ville reale, regia e porta reale, fatti per Carlo VI*, fol., 1768. This is perhaps the *Livre de decorations* mentioned by BLONDEL, *Cours*, 8vo., Paris, 1771, vi, 466. He went 1750 to Dresden, and 1754 to Berlin, where he died 1756-7. 68.

His son GIOVANNI CARLO who, born at Vienna, died 1769 according to some authors, is probably the Carlo, born 1728, who was also celebrated for theatrical decorations. He was engaged 1746 at Bayreuth, and afterwards at Brunswick, Munich, and London. He went from England 1763 to Berlin; 1766 travelled into Sweden, Denmark, France, and Spain; entered the service of the Czar until 1778; and finally settled in Italy. The bizarre staircase in the palazzo Savini now Segni at Bologna is attributed to him by BIANCONI, *Guida*, 12mo., Bologna, 1826, p. 158, who says that he died 1787 at Florence.

GALLI BIBIENA (ALESSANDRO), born probably about 1698 at Parma, worked in the same manner in Italy and Germany. He entered about 1730 the service of the elector palatine, for whom he built the great theatre and the church of the Jesuits at Mannheim, where he died 1760, according to BLONDEL, *Cours*, 8vo., Paris, 1771, vi, 466.

GALLI BIBIENA (ANTONIO), born 1700 at Parma, was also employed at first in theatrical decorations. He executed various works in Italy, but more at Vienna and in Hungary. He published *Architettura e prospettive*, fol., Augsburg, 1740, and he, painting the scenery necessary for them, erected theatres at Pistoja and Siena, and enlarged 1738-40 that called the Pergola for 2,500 persons in five tiers of boxes built 1652 by F. Tacca at Florence. MALASPINA, *Guida*, 4to., Paris, 1819, p. 82, has criticised the theatre built in the strada Nuova near the porta di Milano at Pavia about 1773 by Antonio; who erected 1756-63 at Bologna the teatro comunale; for this structure he made several designs, and the one finally chosen was altered, and according to MILIZIA greatly to the injury of the fabric, which has since been frequently altered, and was completely restored a short time before 1826. The same author, when stating that the theatre built before 1780 by G. Miazzi at Treviso, was designed by the celebrated Bibiena, probably means this Antonio, who was a member of the Clementine academy and painted several *prospettive* at Bologna. He died 1774 at Milan. 68. 105.

GALLERY

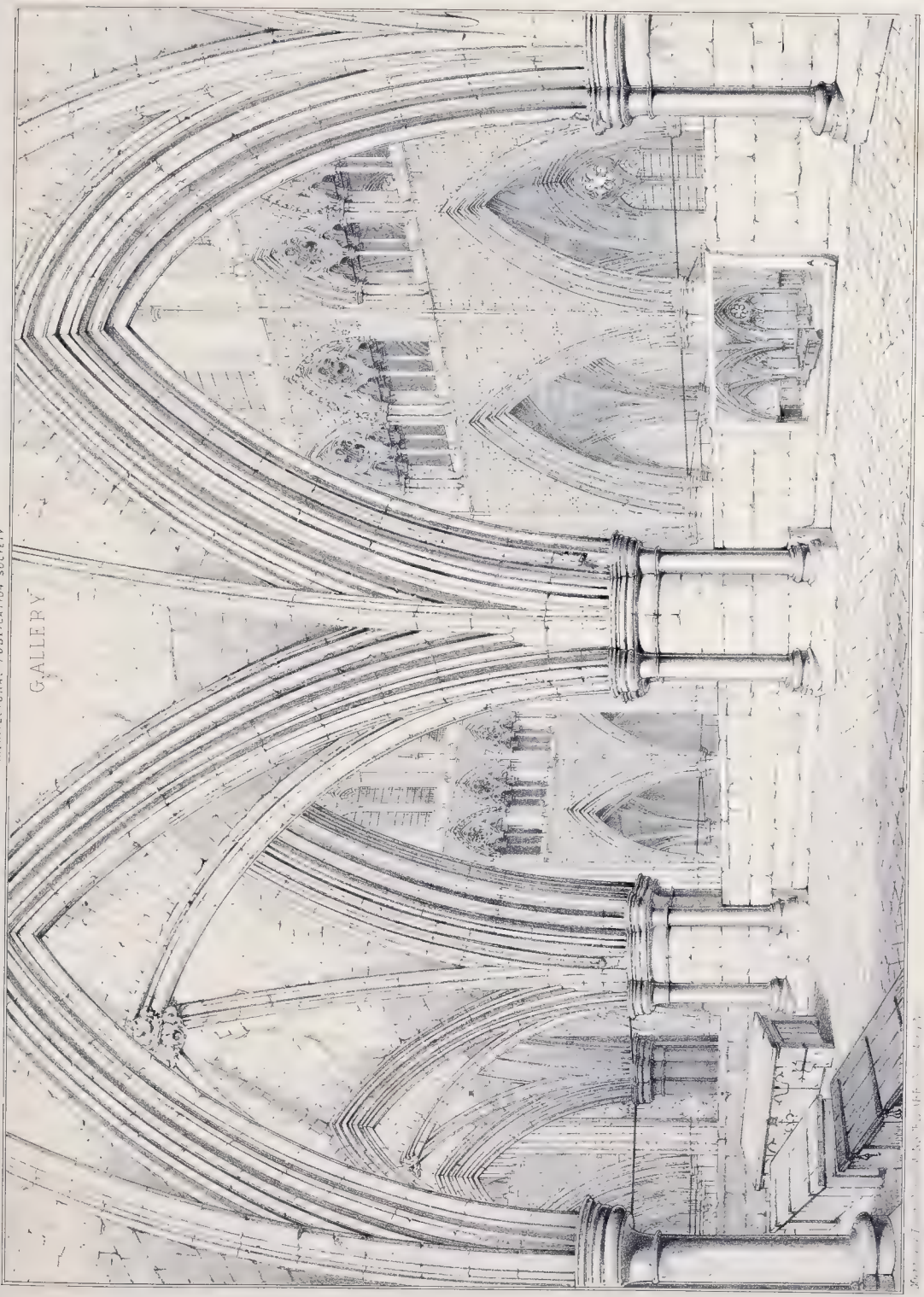


FIG. 1. GALLERY, ST. MARTIN'S, LONDON. (See page 100.)



GALLI BIBIENA (FRANCESCO), born 12 December 1659, was brother of Ferdinando. He painted scenery in several parts of Italy; about 1686 was engaged as architect by the duke of Mantua, for whom he regulated the buildings in that city and built a riding school in the great cortile erected by G. Pippi; arranged the fêtes at Naples in honour of the arrival of Philip V who invited him to Spain; went to Vienna, where he built a theatre, and was treating for 8,000 instead of 6,000 florins as his yearly salary, when the emperor Leopold was succeeded 1705 by his son Joseph who handsomely dismissed him. Galli was invited to London, but went to Nancy in France, where he built the fine theatre, and married. He then entered, with a salary of 7,000 florins, the service of the emperor Joseph, on whose death (1711) he went to Verona, where he built 1716 the celebrated theatre for the Filarmonici, which is criticised by MAFFEI, *Ver. Illustr.*, 4to., Verona, 1731, iii, 180, and which after being injured by fire has been allowed to go to decay; at Rome he built about 1720 the Aliberti theatre. Having settled at Bologna he designed 1730-9 with C. F. Dotti (who executed the work and made alterations in the front) the Voltone or arco del Meloncello; and taught geometry, mechanics, surveying, and perspective, in the Clementine academy, of which he was a member, until his death 20 January 1739. His portrait is given in ZANOTTI, *Storia*, 4to., Bologna, 1739, ii, 265, who states that he left unpublished *Architettura maestra delle arti che la compongono*, in which information upon several of his works is given in the plates and text. 105.

His son GIOVANNI CARLO, who followed in the same path, went 1753 to Lisbon, where he died 1760. 68. 88.

GALLIORI (GIULIO) who appears under the date 27 September 1773 in the register of the architects engaged on the cathedral at Milan, made a design for the front of that edifice, and rebuilt the church of S. Nazaro in Pietra Santa in that city. 26. 112.

GALLIPOLI. A city in the province of Terra di Otranto in Italy. The narrow streets contain no important edifices except a Roman Catholic cathedral dedicated to Sta. Agata, and rebuilt 1575-85 with the attached palace restored 1700, and the nunnery of Teresians dating 1679-1700. 96.

GALLO, see GIAMBERTI (A. and G.) and PICCONI (A.).

GALMENDORA. A rather hard, very fine, but not close grained, heavy wood, of Ceylon. 71.

GALOPIN (....) commenced 1629 the church of the Augustins dechaussés or petits pères, finally finished by CARTAUD.

GALTERIUS appears, from an inscription given by LLAGUNO, 4to., Madrid, 1829, i, 42, part of which reads "positum est hoc fundamentum præsente magistro Galterio q̄ basilikam istam construxit," as the builder of the existing larger church built 1218 for the Cistercians when the Benedictine monastery at Val de Dios in Asturias was transferred to them.

GALVANIC ACTION. The architect has to guard against galvanism, in consequence of the decompositions to which it gives rise in the materials employed by him. When two metals are placed in contact, and water can obtain access to them, especially if the water should be slightly acidulous (as is almost always the case in the rain water of towns where coal is largely burnt, and in all storm waters), a galvanic action is set up, which rapidly develops the tendency to oxidation in the more easily decomposed metal. Thus when iron railings are let into stone plinths, and run with lead, the galvanic action produced by rain water will cause the iron to rust with great rapidity, and the softer descriptions of wrought iron suffer the most from this cause; cast iron is not perceptibly affected by it, within the periods usually considered for house building purposes. During this process the iron expands, and thus destroys the stone into which it is introduced. Some kinds of mixed metals, when immersed in sea water, appear to undergo a species of galvanic decomposition; and it is suspected that the use of red

and white lead stopping, in the joints of plate iron beams, give rise to a feeble galvanic action in them, under the influence of the atmospheric moisture condensed on their faces. The acids contained in the sap of certain woods seem also to give rise to galvanic currents between the ligneous particles, and any metal in contact with them; which may account for the decay of zinc upon oak; of iron fastenings driven into oak; of copper and of bronze sheeting. It is worthy of remark, even at the risk of repetition, that cast iron is not liable to the same distinctly marked galvanic action that wrought iron is when in contact with water; but that, on the contrary, the stone work, around the parts of a cast iron railing run into a stone plinth with lead, will be removed long before the cast iron itself. Good charcoal iron, moreover, suffers more from galvanic action than the modern commercial wrought iron. Notice should also be here taken of the difficulties which arose in the gilding of the ornamental work on the clock tower of the Houses of Parliament, owing to the galvanic action between the gold and the metals in contact with it, which rendered it necessary to regild a portion of the work; a composition was applied, being a perfect insulation between the gold and the metal it covers. Return dated 28 July 1857.

SOCIETY FOR DIFFUSION OF USEFUL KNOWLEDGE, *Electricity and Magnetism*; SMEE, *Electro-Metallurgy*; DE LA RIVE, *Traité de l'Electricité*, and translation by WALKER; wherein will be found a copious list of works on the various branches of the science of Galvanism; DE MONCEL, *Des applications de l'Electricité*; BECQUEREL, *Traité de l'Electricité*; BIOT, *Traité de Physique*; KNIGHT, *Cyclopædia of the Arts and Sciences*; URE, *Dictionary of Arts and Manufactures*; in the *Transactions of the Royal Society*, and the *PHILOSOPHICAL MAGAZINE*, will be found the most important discoveries of Faraday, Daniel, Wheatstone, Gassiot, Grove, etc.; COMPTES RENDUS DE L'Académie des Sciences; BIBLIOTHÈQUE UNIVERSELLE DE GENÈVE; GMELIN, *Chemistry*. The PARLIAMENTARY REPORT on the Construction of Submarine Telegraph Cables, 1861, contains much valuable information upon the most important questions connected with the practical application of galvanic electricity to the arts in general. ATMOSPHERIC INFLUENCE ON BUILDING MATERIALS; CHEMISTRY OF BUILDING MATERIALS; CONTACT; DEPOSITION; DISINTEGRATION; ELECTRO-CHEMISTRY; ELECTROTYPE. G. R. B.

GALVANISM. Galvanism is the principle and the action of electricity in a particular form or condition.

GALVANIZED IRON. The name applied to iron that has been coated with zinc, for the purpose of protecting it from the oxidizing effects of the atmosphere, the covering being a metal which is not subject to such rapid decay by oxidation as is the iron itself. There are two processes employed for this purpose; one without, and one with, tin. The Report of the Commission employed to make experiments at Brest upon the use of galvanized iron (*zingage du fer*) given in DALY, *Revue générale*, 4to., Paris, 1841, ii, 296-318, notices that the former was invented 1742 by Maloin, but not patented until 1836 by Sorel. Its latest modification seems to have consisted in cleaning the iron perfectly by the joint action of dilute acid and friction, plunging it into a bath of melted zinc covered with sal ammoniac, and stirring it about till it was alloyed superficially with this metal. It was supposed that the contact of the two metals gave rise to a galvanic action between them which contributed greatly to their powers of resistance to atmospheric influences; but this could not be the case, inasmuch as there was no fluid interposed between them to excite the chemical changes required for the creation of the galvanic currents; and the protective influence of the zinc coating, in this case, simply consisted in the exclusion of air and moisture from the surface of the iron. The term galvanized iron is in every sense a *misnomer*, and the proper name for this material would be 'zinked iron'.

The efficiency of this zinking process depends upon the care

and skill employed in removing, from the surface to be covered, every trace of scales of the hydrous oxide of iron; the plate must be thoroughly cleaned, heated before immersion, and the zinc perfectly fluid: care must also be taken to prevent the coating from being detached or loosened; for if moisture can obtain access to the iron, through even a very small hole, it will rapidly extend under the zinc covering, and as the scales of the oxide of iron are easily detached, they will remove the zinc above them. Galvanized iron (as it is called) when well executed is remarkably durable; badly prepared metal of this description is not so valuable as well painted iron. As far as possible the work to be done to galvanized iron should be finished before the zinc is applied, in order to avoid loosening the protecting coat. *PRÆ.*

G. R. B.

In 1851 it was stated that "upwards of fourteen years experience has established, beyond doubt, that the smallest as well as the largest articles in iron can be effectually preserved from rusting by the process termed 'galvanizing.' Iron thus protected cannot be corroded, unless by the action of acids, either by exposure in the open air; in fresh or salt water; or buried in the ground; even though the external surface may have been partially rubbed away. As it is effectually protected from rust, it is a valuable and cheap substitute for other metals." Experience has, however, considerably modified the opinion thus positively put forward. At the Houses of Parliament, for instance, it was found necessary from 1860 to commence coating the plates, on both sides, with paint or some other more preservative material, after carefully scraping off the scales of rust, dirt, etc.: this roof is described in the *QUARTERLY PAPERS on Engineering*, 4to., London, 1844. In 1849 the *BUILDER Journal*, vii, 113, commenting on a piece of galvanized iron from a cistern erected two years, it being full of holes, says that remembering the high opinion of this material expressed by Professor Brande and others, and that it is now being extensively used, the public should have the means of judging between that which will last and that which will not; one company asserts that in their process no admixture of tin is used. The same *Journal*, p. 157, notices the existence of two manufacturers, namely, the Galvanized Iron Company using Crauford's patents, and the patentee of the Tinned Iron: and remarks that Dr. Ryan says "there are circumstances under which galvanized tinned iron is not applicable; for instance when the medium in which it is placed contains acid or acid vapours, an action takes place which must sooner or later destroy the metal"; and he points out the true galvanic action of zinc in water containing a salt of either iron, tin, copper, or lead.

The other process which furnishes a material that might be denominated 'zinked tinned iron', has been thus described. The sheets of iron are pickled, scoured and cleaned as for ordinary tinning; a wooden bath is half-filled with a dilute solution of muriate of tin; over the bottom of the bath is then spread a thin layer of finely granulated zinc, then a cleaned iron plate, and so on alternately; the zinc and iron, together with the fluid, constitute a weak galvanic battery, and the tin is deposited from the solution, so as to coat the iron with a dull uniform layer of metallic tin in about two hours. The iron in this state, is then passed through a bath containing fluid zinc, covered with sal ammoniac mixed with an earthy matter, to lessen the volatilization of the sal ammoniac, which becomes as fluid as treacle. Two iron rollers immersed below the surface of the fluid zinc, are fixed to the bath, and are driven by machinery to carry the plates through the fluid metal at any velocity previously determined. The plates are received singly from the tinning bath, drained for a short time, and passed at once, whilst still wet, by means of the rollers, through the bath as described. The plates take up a very regular and smooth layer of zinc, which owing to the presence of the tin beneath, assumes its natural crystalline character. This is said (1860) to be Messrs. Morewood and Rogers' process; and it is

asserted that iron thus prepared does not warp or buckle; that the plate is not affected by the heat of the zinc, whereas thin sheet iron kept in molten zinc for a few minutes, becomes so brittle that it will not bear folding or grooving; that the plate is equally covered with zinc, whereas by the dipping process the lower half receives more than the upper; and that zinc is not contaminated by iron as when dipped, the contamination increasing with each dipping, until the zinc in the bath becomes so injured as to be worthless, it being well known that the alloy of zinc and iron is more oxidizable than zinc alone, or than zinc and tin. The zinked tinned process was employed in 1841 in the East and West Indies, and America; various works for the Admiralty; Clarence Dock sheds, and new Albert Dock warehouses, Liverpool; and Blackwall, and other railway stations and sheds.

It is stated that bolts or other fastenings of copper must be isolated by a covering of felt or strong brown paper, soaked in a preparation of shellac dissolved in essential oil of tar, to prevent a chemical action between the copper and the iron. In joining galvanized iron with solder, care should be taken that the solder soaks well between the laps. Spirits of salts killed by putting about three ounces of zinc to a pint of spirit must be used in the soldering.

Experiments made with bolts and screws of iron and of galvanized iron, driven through pieces of oak, and then immersed in soft and sea water for three months, shewed that the friction did not remove the zinc from the iron; and that the oak and galvanized bolts were unchanged; whilst the iron bolts were much rusted, and the pieces of oak had become quite black by the formation of tannate and gallate of peroxide of iron. During the experiments the waters were changed every week, and those containing the galvanized iron appeared unchanged; whilst in the case of the iron they had a dark blue-black appearance owing to the formation of gallate and tannate of iron. Dr. Calvert also found that the action of water on galvanized iron was less than a tenth of that on ordinary iron. These experiments are reported in the *Transactions of the Manchester Philosophical Society for 1862*, and reprinted in the *CHEMICAL NEWS Journal*, April 5, p. 193.

In December 1859 it was stated that a new process of galvanizing iron wire had been recently discovered, at Paris by M. Cuhe, "the chief advantage over the old method consisting in its allowing a very thick coating of zinc which adheres in a most perfect manner, to deposit itself on the wire, which, not being afterwards subjected to any friction whatever, prevents any hindrance to the crystallization, and consequently resists much longer the action of chemical agents," etc.

GALWAY. The chief city in the county of the same name in Ireland. It will be only necessary to state that the peculiar architecture of this town since the fire of 2 June 1473, has been described by WRIGHT in the *Journal of the Archaeological Association*, i, 94, and reprinted in *BUILDER Journal*, iii, 400. HARDIMAN, *History of Galway*, 4to., Dublin, 1820.

GALWAY MARBLE. The so called 'black marble' of Galway in Ireland, belonging to the limestone district of the county of Clare, occurs in thin beds, covered by a considerable thickness of coarse limestone used for building purposes. It is quarried principally at Menlo, on the border of Lough Corrib about three miles from the town. The upper bed of limestone is quarried by gunpowder to within three feet of the marble; the heavy labour of raising the stone by mechanical means, adds to the cost of obtaining the marble. The beds are three in number; 1, the upper bed, about 9 ins. thick; 2, the middle or London bed, so called as being the best for the London market, about 12 ins. thick; and the bottom bed about 13 ins. thick, nearly equal in quality to the London bed, and divisible by wedges into two layers. Below this the material is not worked, being of a lighter colour, streaked with quartz veins, and in other respects objectionable. Blocks can be raised from 5 to 10 ft. long and from 4 to 5 ft. wide; it is worked into

shape on the spot, or divided into slabs an inch thick and packed in cases. Slabs 16 ft. long have been worked in London into landings, steps, and balusters, for the staircase at the duke of Hamilton's palace in Scotland.

The green and white marbles of the same county, belong geologically to the slate district, being obtained from the beds of primary limestone. The white marble is of a pure colour, very hard, and of fine crystalline texture; but owing to the numerous coloured streaks or laminæ, parallel to the bedding, no cubical shaped blocks of any size can be obtained; stone of limited thickness but of several feet square, can, however, be procured.

Very handsome green marble, or rather serpentine, abounds in the same district, and was formerly more extensively used than at present. It occurs in blocks, having a very rough and rugged surface, either loose and overlaying the surface near their natural beds, or in solid rocks, the extent of which is not however great. The frequent use of gunpowder in quarrying has much prejudiced the sale of this marble in consequence of the injury done to the blocks. WILKINSON, *Geology, etc., of Ireland*, 8vo., Lond., 1845, 273.

This green Connemara marble, as it is usually called, is obtained at Ballinahinch in Galway; the most valuable quarries are situated near Clifden; *Guide to the Museum of Practical Geology*, Lond., 1859. GRANITE of Ireland.

GAMARD, GAMARE, or GAMART, who was practising about 1630 at Paris, designed the church of S. André des Arcs; the hôpital des incurables; and a portail for the church of S. Germain-des-Prés, engraved by J. Marot. BLONDEL, *Arch. Franç.*, fol., Paris, 1751, ii, 37, and *Cours*, 8vo., Paris, 1772, iii, 330, notices that Gamard designed 1646 the church of S. Sulpice, and that the first stone was laid by Gaston d'Orléans; but that the intended building was afterwards considered too small for the then daily increasing number of parishioners, so that in 1655 it was resolved to erect the church that now exists, and which was designed by Leveau. 68.

GAMBHARI WOOD, see GMELENA.

GAMBOA (PEDRO DE) became 1572 *aparejador*, and 1577 maestro mayor of the cathedral at Salamanca. Although he was a mason (maestro de cantería), he was one of the most skilful architects of the period in Castile. He died 1585. 66.

GAMBOGE. The corrupted form of *Kamboja*, the name of the sole country where this yellow gum resin is found; CRAWFORD, *Descr. Dict. of Indian Islands*, 8vo., Lond., 1856. In the Malay language it is termed *rong*; in Persian and Sanskrit *rang*, colour or paint. CAMBOGE.

GAMIEL. A mistake for GUMIEL (PIETRO DI).

GAMODIA, see AHRLER (HEINRICH); ARLER (HEINRICH); ARLERI or ARLIERI (PIETRO); GEMUNDEN; GMEUND; and ZAMODIA.

GAND (Flem. *Gend* or *Gent*; Engl. *Ghent*). A city in Belgium, the capital of East Flanders, situated at the confluence of the rivers Scheldt, Lys, Liève, and Moere, whose branches intersect the town, forming twenty-six islands, connected by numerous small bridges of stone and wood. Some of the older streets are narrow and intricate, with houses having gabled fronts; while in the other quarters, the streets are straight and spacious, with rows of well built houses. Among the examples of domestic architecture are the *Gerard Dievel steen*, of stone, 14th century; the *Grande Ameyde*, a large square building flanked by towers; another, 14th and 15th century, formerly isolated, with a lofty turret at one angle reduced in 1805, had formerly one large room lit on two sides on the first floor, used for the meetings of the leading burgesses, the ceiling on beams was supported by ten niches with statuettes of saints, of which only one exists; on the upper story was also a large room with a good open oak roof; a few other examples date early in the

seventeenth century: there are vast subterranean constructions under and around the Marché au Beurre. The house for baron de Meulenaere, 1792, by J. B. Pisson, is given in GOETHE-BUER, as well as the maison des Bateliers, 1531, of red brick and stone; five houses, in the rue pont de Fer (Flamboyant), by Roelandt, are given in CASTERMANS. The places are large and many; the *kauter*, or place d'armes, is planted with lime trees and surrounded by good modern buildings; the boulevards on the ancient ramparts, ruined in the beginning of the sixteenth century, are about six miles in circuit, and now entered by seven gates (formerly eight), of which the porte de Courtrai, 1808, had the corps de garde, 1809, by P. J. de Broe (who is said to have built those at the two following gates); that of Bruxelles, 1300, restored 1523; of Bruges; of S. Peter's, 1430, reconstructed 1827; S. Lievin, 1300, now in ruins; of Antwerp, 1570, rebuilt 1782, and again 1830, and much admired; and of Sas de Gand, rebuilt 1426, and again about 1837.

The Oudenburg or 's Gravensteen, in the place S. Pharaïde, a relic of the castle of the counts of Flanders, consists of an archway, built 868, and the two flanking turrets, 1180. The modern citadel was erected 1822-30, and the *grande caserne d'infanterie* 1687-1732.

The church of S. Bavon (Flem. *S. Baefs*), formerly dedicated to S. John, made cathedral in 1559, is a three-ailed cruciform building with chapels and apsidal choir and chapels. It was founded 941, and rebuilt 1228-76; the crypt has four aisles, part being older than that period, and the eastern portion not earlier than the end of the thirteenth century; the choir 1274 was completed in the early part of the fourteenth century; the five apsidal chapels are of the fourteenth and fifteenth centuries. The tower 1461-1534 by J. Stassius, 268 ft. high, was formerly surmounted by a wooden spire destroyed by fire in 1603. The nave, aisles, chapels, and transepts, date 1533-54; the vaulting, portail and turrets flanking the west front, are of the end of the seventeenth century; the interior wooden portail was put up 1572. In the crypt are two ancient altars; one with masonry under the *mensa* which is 4 ft. 4 ins. high; the second is 7 ft. by 4 ft. 6 ins. wide, resting on a ledge on the wall side, and on a stone in front. The choir and transepts are lined with black marble; the balustrades of white or variegated marble, are with the screen and altars, of Italian architecture; the three gates of brass by W. de Vos, 1708, cost 12,355 fl.: statues and paintings fill every vacant place: the richly carved pulpit, 1745, by L. Delvaux of Gand, cost 33,000 fr.; the stalls of the canons, of mahogany, cost 46,000 fl. The statue of S. Bavon on the high altar is by Verbruggen, and in front stand four tall candelabra of brass and copper, formerly belonging to Charles I. of England (the drawings by L. Roelandt in the library of the Royal Inst. of Brit. Archts., are engraved in the *Illustrations*, 1857-58). The sacristy, fourteenth century, has a chandelier of cast iron of early fifteenth century work, with twelve oak branches, deserving attention.

The total inside length from west door is 380 Eng. ft.; the nave is 147 ft. 6 ins. to the screen, 43 ft. 3 ins. wide, and 113 ft. 2 ins. including the chapels and aisles, which latter are each 21 ft. 3 ins.; the transepts are 140 ft. long and 37 ft. 9 ins. wide; the choir is 150 ft. 10 ins. long from the screen to the gates of the end chapel (the chapel 38 ft. 5 ins. deep), and of the same widths as the nave. The west tower is 32 ft. 10 ins. square inside, and 46 ft. outside. These dimensions are taken from the plan given in ROME, *Chiese Principali*, fol., Milan, 1824.

The church of S. Nicholas, the most ancient, is a three-ailed cruciform building with apsidal choir and projecting chapels, chiefly rebuilt, of Tournai stone, after the fire of 1120; the lower part of the tower is of the twelfth century, the upper part was rebuilt 1406 by J. Thierri de Steenhoukefelde; its portail (Ionic) dates 1825; the choir was renewed and apse rebuilt by Boonen (or Boene) and Colins 1427-9, again renewed in 1582 and 1623; the jubé and organ buffet are by de Broe. S. Michael, the largest, a three-ailed cruciform church with

apsidal choir, was rebuilt 1440-1598; the fine square tower 1445-1515 (windows and vaulting 1827), was to have had a timber spire making a total height of 400 ft. S. Pierre, founded seventh century, was rebuilt 1629 by Jan van Santen and finished 1670 by Matheys; it is about 120 ft. square at the entrance, over which is a dome 44 ft. in diameter by 180 ft. high, erected 1719; the part beyond, or choir, is 174 ft. long and 105 ft. wide. S. Jacques, of three aisles and cruciform, was rebuilt soon after the fire of 1120; the towers date 1130, the remainder is as late as 1415; the pulpit is by J. J. Dutry (WEALE says 1787 by C. von Poucke). S. Sauveur, founded 1370, rebuilt on another site 1560, is cruciform; the interior modernized 1806 by Goewie; the façade 1810-11 and organ buffet are by de Broe; and the choir was rebuilt 1857-8 by Langerock. S. Martin (Ackerghem), founded tenth century, was rebuilt 1616. S. Etienne (Augustine), founded 1296, rebuilt 1602-22, was injured by fire 1838. Ste. Anne and S. Antonio di Padua was rebuilt, first stone 1 Sept. 1853-59 by Roelandt. The oratory of the Dominicans was founded thirteenth century; the church, 1240-75, had a nave about 167 ft. by 53 ft. in the clear, with ten chapels on each side between the buttresses, and a timber vault about 1700 by Francesco Romain, were pulled down 1861; a plan is given in the GENTLEMAN'S MAGAZINE, 1862, p. 295. The new Dominican church, 1856, is by Van der Capelle. The Jesuits' church (Ionic) is by Père Megang. Of the old monastery of S. Bavon, founded 631, some walling may date 654; parts of the west side of the cloister 1013-18; the crypt of S. Mary 1148; a pavement of coloured tiles of the thirteenth century; and a small octagonal baptistery, afterwards chapel of S. Macarius, 1067, or 1179 by others, this has an altar of brick with a mensa of blue stone. La grande béguinage, for 650 females, comprising about a hundred and twenty houses and eighteen convents, of red brick and white stone, built in streets and squares surrounded by a wall and moat with one gate, was founded 1234; its first chapel, 1242, was rebuilt in the seventeenth century; the chapel of S. Anthony (Second Pointed), 1852, is by Croquison. La petite béguinage, for 400 poor females, founded 1234, is of corresponding extent.

The episcopal palace (Flamboyant), 1842, is by M. Wolters; the hôtel du gouvernement was restored and enlarged by Roelandt; the hôtel de ville (late Flamboyant) was commenced 4 July 1481 by J. Stassius, who was succeeded 1527 by D. de Waghemakere and R. Keldermans; they pulled down the façade and rebuilt the lower portion in the rue Haute Porte (*Illustrations*, 1854-5, s. v. Balcony; and 1859, s. v. Gable); the turret at the angle with part adjoining, 1527-60, is by Eustace Pollet; the north end dates 1580; the other façade, 1595-1618, is of three orders, 136 ft. long; the staircase in front, 1518, is by de Broe. The palais de justice, 1839-44, is by Roelandt, the ground floor serves as the exchange, and has a hexastyle pseudo-dipteral Corinthian portico. The beffroi dating from 1183, of Tournai stone, has five bell towers; the centre one, 236 ft. high, containing the large bell of 11,000 lbs., was rebuilt 1315-77 (37, WEALE), repaired 1839-55, when the spire was designed by Roelandt (the original drawing on vellum, thirteenth century, with two others of it later, exist in the archives of the town; with one of the hôtel de ville, cir. 1526); the dragon on the top, formed of thin plates of copper nailed to iron framework, was then again regilt; it is generally said to have been brought from Constantinople in 1204, given to Bruges, and brought from thence in 1382. The palais de l'université, founded 1816, first stone laid August 1819-26, by L. Roelandt, has a noble Corinthian portico of eight columns, under which is the door of bronze; the sculpture in the pediment is by de Calloigne; the entrance hall, staircase, and amphitheatre are much admired; the library of upwards of 70,000 volumes, besides 690 MSS., is kept in the church of the old abbey of the Benedictines of Baudeloo. The musée and academy, in a building constructed 1738 for an Augustinian college, was given to the academy in 1804; the old salle is by de Broe; additions were

made 1827 by Roelandt: there are also an episcopal seminary, schools for the poor, founded 1623; six communal schools; with scientific and other institutions.

Among the twenty-one public hospitals are that of the Byloque, founded 1225, providing for 600 persons; the great hall has a large oak roof (said to be of chesnut) a *chef d'œuvre* of carpentry (SCHAYES, iii, 165); the gable of the refectory is of ornamented brickwork, with a fine roof; the paintings date the end of the thirteenth century: the hospice de S. Catherine was rebuilt in the seventeenth century, the chapel dates 1543-9: the hospice de S. Laurence, sixteenth century, of red brick and stone, was restored with care 1854-8: the maison de force, or centrale de détention, was built 1772, at a cost of £48,000; the remainder, 1824, by Roelandt, cost £40,000; it forms an octagon of vast extent with wings to a centre octagon having a court in its interior, and accommodating upwards of 2,600 prisoners, half only being usually in detention at one time: the pest-huys is by van der Linde: and the rasphuys by Malfeson. There are also a deaf and dumb institution, and a lunatic asylum.

The marché du Vendredi (*vrijdags markt*) was the meeting place of former times of the various guilds; the halle au blé dates 1323, but its appearance is that of a century earlier, it shows one of the earliest examples of a crow-stepped gable; the marché au poisson, 1689, was built by A. van der Linde on plans by A. Quellyn; the grande boucherie dates 1408, its chapel has a mural painting in oil of the fifteenth century, discovered in 1855. The petite boucherie; the halle aux draps with two turrets erected 1424; the hôtel de l'octroi, 1721, by B. de Wilde; and the abattoir on the site of the old castle, 1855-6, are among the other public buildings.

The theatre, 1837-9 by Roelandt, its saloon concert room, and ball room, cost 2,500,000 fr.; a salle de la concorde is given in CASTERMANS; the new casino, 1837, is by Roelandt; the jardin des plantes, 1797, is the finest in Belgium, its orangery, 1829, is also by Roelandt: the three club houses of the military, nobles, and merchants; the railway station, 1850, of Pierre bleu stone; and the large square in front formed 1839, may also be noticed.

28.
GOETGHEBUER, *Choix des Monumens*, fol., Gand, 1827; DIERICK, *Mém. sur la ville de Gand*, 8vo., Gand, 1814-5; WATERS, *Les délices de Belgique*, 8vo., Brux., 1846; HEATH, *Picturesque Annual*, 8vo., London, 1841; SCHAYES, *L'Arch. en Belgique*, 12mo., Brux., 1850-53; CASTERMANS, *Parallèle des Maisons*, etc., fol., Paris, 1850-4; GRANVILLE, *S. Petersburg*, etc., 8vo., London, 1835, i, 30, gives some woodcuts; W. H. WEALE, *Handbook for Belgium*, etc., 12mo., London, 1859; VOISIN, *Guide de Gand*, 4th edit., 8vo., Gand, 1840; Paper by J. A. PICTON in *BUILDER Journal*, xiii, 135; and other books named s. v. Flemish Architecture.

GAND (SALOMON and THOMAS DE). Salomon de Gandavo is mentioned as the tenth abbot, 1226-31, and Thomas de Gandavo as the fourteenth abbot, 1265-77, of the Cistercian monastery of Notre Dame des Dunes, afterwards rebuilt, near Bruges. The monastic buildings were continued by Salomon, and completed by Thomas, who built the lodgings of the prior and cellarer. SANDERUS, *Flandria*, fol., Cologne, 1644, i, 249.

GANDOLFO (GIROLAMO) of Valle dell' Oreglia, with three others, designed 1655-60 the albergo dei poveri at Genoa, as noticed s. v. CORRADI. He also opened the street and constructed the gate called de' Carbonara or dell' Albergo, leading to that building. He died of the plague in 1657.

37.
GANDON (JAMES), the grandson of a native of Blois in France, was born in London 29 February 1742, o. s. After studying at Shipley's drawing academy, he became a pupil of Sir W. Chambers, and commenced practice about 1764. He published, in conjunction with John Woolfe of the Board of Works, a continuation of CAMPBELL's *Vitruvius Britannicus*, 2 vols. fol., 1767-71; which contains (ii, 77-80) his design, obtained in competition, for the county hall and prison at Not-

tingham, erected 1769-70, at a cost of £2,500. In 1767 he exhibited at the Incorporated Society of Artists "a mausoleum to the memory of Handel, erected in the demesne of Sir Samuel Hillier in Staffordshire": among other designs of this time were, alterations for Sir H. Oxendon in Kent; and a screen wall erected for Mrs. Montague in Portman-square. On the foundation of the Royal Academy of Arts in 1768 he became a student, and obtained the gold medal first given for architecture, the design being a triumphal arch commemorative of the Seven years' war. In 1769, being one of sixty-four competitors, he obtained the third premium of thirty guineas for a design for the royal exchange in Dublin (erected by T. Cooley); and 1776 that of one hundred guineas for New Bethlehem hospital, London (erected by J. Lewis). Between 1774 and 1780 he exhibited drawings at the Royal Academy, among which, in 1777, was an elevation of the principal front of Warley Place. At the instance of Lord Carlow, afterwards Lord Portarlington, he made 1780 plans for the new docks, stores, and custom-house at Dublin, proceeding there early in 1781 to carry out the works; this building, completed in 1791, is a noble pile 375 ft. by 209 ft., which would do credit to any city in the world. In 1784 he designed the united court house and gaol for the city and county of Waterford; 1785 the east portico and ornamented circular wall to the House of Parliament in Dublin (the three quarter columns were added when altered for the Bank, and the steps filled up); he laid the first stone 3 March 1786 of the Four (Law) Courts (the offices of records and south and west portions of the quadrangle were erected by T. Cooley 1776-84), first used 8 Nov. 1796; in 1798 the foundations were laid for the east wing of the offices; and in 1802 the screen arcade and wings of the offices were also completed by him. In 1786 he designed additions to the House of Commons in Foster-place (appropriated by others); presented drawings for the military hospital in the Phoenix Park (carried out under W. Gibson); 1791-4 erected Carlisle bridge; and 1795, Aug. 1, laid the first stone of the Inns of Court, Henrietta-street.

Considering it advisable to leave Dublin in 1797 in anticipation of the rebellion of the following year, he visited London, but returned in 1799 to complete the custom-house and Inns of Court, the control of which latter he resigned in 1808 to his pupil H. A. Baker. He had purchased property in 1805 near Lucan, in the county of Dublin; and CARLISLE, *Dict.*, s. v. Canon Brook, records that "the great improvements in planting here by J. Gandon, Esq., deserve the best commendations, and are examples to the nobility and gentry of Ireland": to this residence he retired in 1808; and died there 24 December 1823, in the 82nd year of his age; but he was buried in the private chapel of Drumcondra near Dublin, in the same grave with F. Grose.

The small library at Charlemont house, Dublin, is perhaps a work of 1782; the excise office in London, pulled down 1854, is sometimes attributed to him, but is a work of W. Robinson. He was elected 1791 an original honorary member of the Architects' Club in London, and 1797 a fellow of the Society of Antiquaries. An essay on *The Progress of Architecture in Ireland*; and *Hints for erecting Testimonials*, are given in MULVANY, *Life of Gandon*, 8vo., Dublin, 1846 (reviewed in *Builder Journal*, 1847, v, 1), which was arranged by his only son James, and gives his portrait, and details the difficulties respecting the foundations and the workmen, met with in the erection of the buildings in Dublin. MALTON, *Pict. and Descr. View of the City of Dublin*, fol., Lond. and Dub., 1704, whose son James (or Thomas) was also a pupil of Gandon's (MULVANY, 218); and the late Sir Richard Morrison was in his office when a youth. 14. 61.

GANDY (JOSEPH MICHAEL), born 1771, was a pupil of James Wyatt, and travelled 1793-99. The Phoenix fire, and Pelican life, insurance offices, Charing Cross, London, 1804-5; and various additions to the court and county prison at Lancaster 1802-23, are his best known buildings. The catalogues

of the annual exhibition at the Royal Academy of Arts in London contain the names of many of his clever artistic conceptions of architectural restorations, with arrangement of details, commencing 1811, about which year he became connected with the studio of Sir John Soane, whose museum possesses many of Gandy's drawings; he also made illustrations for publications, such as BRITTON, Roslyn chapel, in the *Architectural Antiquities*, iii; Exeter cathedral, etc. The catalogues also mention the following designs; 1804, a boat-house on Windermere for Sir J. Legard, Bart.; 1806, public bath at Lancaster; 1807, for rebuilding of Ballon town near Carlow, for J. Marshal, Esq.; 1808 and 1811, Storrs hall on Lake Windermere, one of the seats built for J. Bolton, Esq.; 1810, an assembly room at Liverpool, where he was located 1809-11; 1812, new senate house for Quebec; 1813, three villas to be erected in Lancashire; 1818, a house, building at Sion-hill, Bath; 1819, house and offices near Leytonstone; and villa near Birmingham; 1820, proposed additions to Clumber, for the duke of Newcastle; 1825, dwelling houses, etc., building in the Vauxhall Bridge-road, and other places; 1826, subscribers' billiard room at Liverpool erected by him; and 1832, entrance hall at Ince, near Southport, Liverpool, for H. Blundell, Esq.

He was elected an A.R.A. in 1803; published *Designs for Cottages and Rural Buildings*, 4to., 1803 (?); *The Rural Architect—Designs for Country Buildings*, 4to., 1805; and died Dec. 1843. He left one son, Thomas Gandy, a portrait painter, by whom these articles have been revised.

GANDY (MICHAEL), born 1778, was a pupil of his elder brother Joseph. He was in James Wyatt's office, and whilst there accepted an offer made by him of an appointment in the Indian naval service; went to India and China; and on his return was employed for some time in the drawing office of Mr. Holl, civil architect to the Navy at Somerset House; also by F. Goodwin; and afterwards by Sir Jeffry Wyatville, having been with him thirty-three years at the time of that architect's death in 1840. He published with Benj. BAUP, *Architectural Illustrations of Windsor Castle*, the text by J. Britton, fol., London, 1842. In the catalogue for 1812 of the Royal Academy of Arts in London, is "The burning of Onrust and Kupers Island, Batavia, in 1800, drawn on the spot", apparently the only work exhibited by him. He died April 1862.

GANDY-DEERING (PETER JOHN, also known as J. P. Gandy, Gandy Deering, and J. P. Deering from 1828), another brother, born 1787, was in the office of James Wyatt (1805-8); and entered the Barrack office, which appointment was retained for him when sent by the Society of Dilettanti in the second mission to Greece with Sir W. Gell, F. Bedford, and J. Walter, 1811-13: the results of whose labours are given in that Society's *Unedited Antiquities of Attica*, comprising the remains at Eleusis, Rhamnus, Sunium, and Thoricus, fol., London, 1817; and in the third volume of the *Ionian Antiquities*, giving Cnidus, Aphrodisias, and Patara, fol., London, 1840. With Sir W. Gell, F.S.A., he published *Pompeiana*, 4to., London, 1817-9, to which he contributed the text. (A French translation of this work by Hittorff appeared in 1827.)

He was associated with W. Wilkins, R.A., in the erection of the United University club house, Pall Mall East, 1822-6, costing £26,500 (the attic story was added by another architect in 1850-1); and the London University college, Gower-street, 1827-8. He designed S. Mark's church, North Audley-street, 1825-8, costing £5,600; Exeter hall, Strand, 1830-1, costing £30,000; and the Pimlico literary institution, Ebury-street, 1830. Among his designs sent to the exhibition of the Royal Academy of Arts in London, commencing in 1805, are the following: 1826, with W. Wilkins, a model of the tower of Waterloo, 280 ft. high, as selected by the Committee of Taste; 1827, almshouses for Mr. Fryer near Stamford; lodge at Dumfries house, for the marquis of Bute; portico of entrance to Broomhall, Fifeshire, for the earl of Elgin; 1829, entrance front to Broomhall; 1831-3, south front of Shrubland park,

Suffolk, for Sir W. F. Middleton, Bart.; and 1832, new lodge of approach to Burghley, for the marquis of Exeter. He was elected A.R.A. in 1826; R.A. in 1838; appointed high sheriff of Buckinghamshire in 1840, being then resident at The Lee, Great Missenden; elected member of parliament for Aylesbury in the same county, in 1847; and died 2 March 1850, aged 63 years. He was distinguished by the purity of his taste, his perfect knowledge of Greek architecture, and the refinement and elegance of his drawings.

GANGUE (It. *pietra metallica*; Fr. *gangue*; Ger. *gang*). In mining operations this word is applied to the substance which lines the fissures of the rock, and forms as it were a case for the mineral vein. Carbonate of lime, blende, and iron pyrites, are usually the gangues of lead veins; quartz and pyrites are those of copper; sulphate of lime and the metallic sulphurets are often the gangues of zinc; whilst the fluates of lime, sulphate of baryta, etc., are gangues to other metals. Some modern authors apply the word to any extraneous body introduced into an hydrated compound of any description, for the purpose of forming a nucleus around which the compound may crystallize upon the solidification of the requisite dose of water. The ballast in concrete thus serves as the gangue for the hydrated lime mixed with it.

G. R. B.

GANISTER. A quartzose, semicrystallized, volcanic rock found upon the upper coal bed in the neighbourhood of Sheffield and Newcastle. It is an efficient firestone; when ground to powder by edge runners and worked into a plastic state with water, it is used as a lining for furnaces and retorts as being capable of resisting intense heat during the fusion of metals and glass. Where it is very plentiful, its hardness renders it suitable for macadamizing roads, the road scrapings of which (being ground ganister) are then used for furnace linings; HULL, *Coal Fields*, 8vo., Lond., 1861; *Transactions of the Inst. of Civil Engineers*, 1860.

R. R. R.

GANKOFFEN (JOERG) of Halspach is commemorated, according to SIGHART, *Die Frauenkirche*, 12mo., Landshut, 1853, by a portrait and an inscription, which state that he died on the Monday after S. Michael 1488, having laid the first, middle, and last stones of that church, commenced 1468, and now the cathedral, at Munich. The churches at Feldkirchen and Gellersdorf are also ascribed to him.

68. 92.

GAOL or **JAIL**, see **PRISON**.

GAOU of the French, see **ANTÆOPOLIS** in Egypt.

GAPMOUTH. A term applied to a sort of GARGOYLE, but which does not appear to have been so used, being more like the head of a rain water pipe; it occurs at the manor house of South Wraxall, Wiltshire; WALKER, *Examples of Gothic Arch.*, 4to., London, 1838, pl. 10, 16.

GARAYZABAL (MIGUEL DE) continued 1603-17 the erection of the church of the Franciscan nunnery of the Conception at Eybar in Guipuzcoa, begun by H. de Loydi after the design made by M. de Aramburu.

66.

GARCIA (ALVAR) of Estella, the reputed designer 1091-1107 of the cathedral at Avila del Rey. His existence is considered doubtful by Risco, *España Sagrada*, xxxviii, 134.

GARCIA (ANDRES) continued after the death of M. Lopez 1596 the monastery of the Minims at Toledo; and was himself succeeded by J. Martinez Calvo.

66.

GARCIA (A. and G. and J.), see **QUINNONES**.

GARCIA (C. and P.), see **MAZUECOS** (C. GARCIA DE).

GARCIA (ESTEBAN) being maestro-mayor of the archiepiscopal works at Seville, although simply a mason, was commissioned to prepare the design for the collegiate church of S. Salvador in that city. The first stone was laid 1 December 1674, but he was dismissed 29 October 1678, and 24 October 1679 the arches and pillars fell to the ground: the result as far as Garcia is concerned is not known, but it may be supposed that he was to some extent justified by the favourable report of a commission 17 July 1678 upon the works which he then proposed.

66.

GARCIA (JUAN), see **PEDRO** (J. GARCIA DE SAN).

GARCIA (DON JOSEF), born 12 May 1760 at Novelda in Valencia, was a pupil of his father and of V. Gasco; obtained 1783 the highest prize in the academy of S. Carlos at Valencia, and was elected 15 April 1785 a member of that body, in which he became 27 November 1791 assistant director and professor of mathematics till 12 October 1794, when he resigned from infirmity. He designed the baths of the general hospital, the house of Don F. Oliag, that of the *magister* (a dignitary of the cathedral) in that city; and in the environs the capella del Sagrario to the church at Manises, the churches at Benafer, Caudiel, Jerica, and Requena; and the cathedral at Ivica. He held the posts of maestro-mayor to the city and chapter of Valencia, where he died 30 June 1796.

66.

GARCIA (PEDRO) was maestro-mayor of the chapter at Seville in 1421: the cathedral is said to have been designed about 1401 either by his predecessor A. Martinez or by him.

66.

GARCIA D'EMERE, see **EMERE**.

GARDENIA. A BLACK WOOD of the Cape of Good Hope.

GARDENING, see **LANDSCAPE GARDENING**.

GARDEN WALL BOND. The same as **FLYING BOND** and **YORKSHIRE BOND**.

GARETTA, see **GARRETTA**.

GARGOYLE, formerly written gargle, gargyel, gargayle, gargyle, gargulye, and now often GURGOYLE (It. *doccia di gronda*; Sp. *gargola*; Fr. *gargouille*, *canon de gouttière* is the pipe through it, and *gargouille* is used for the pipe from the down pipe of a house to the gutter in the road; Ger. *wasserspeier*). A projecting spout in mediæval buildings which conveys the rain water from the roof gutter, and shoots it forth clear of the wall. The word is said to be derived from *gargale*, an old French word for a disease in the throat of swine which causes them to make a 'gurgling' noise. Gargoyles are sometimes plain leaden spouts; at others, simple stone channels; but they very frequently take the form of grotesque figures of men, animals, or demons, with open mouths whence the water is ejected. It has been remarked that Marchione of Arezzo (cir. 1200), invented these grotesque spouts, but this assertion appears to have been made on a misconception of the words used by WALPOLE, *Anecdotes*, 4to., London, 1762, i, 111; who quotes FELIBIEN, *Vies*, 12mo., Trevoux, 1725, v, 224; probably obtained from VASARI (*Lives*, 8vo., Lond., 1850, i, 50). Abroad they have a greater projection generally than those in this country. Gargoyles are of very rare occurrence before the Early English period. They are sometimes contrived to form part of the cornice below the parapet, and sometimes pass through the tops of the buttresses below the gables. In England a lead spout generally passes through the stone figure and projects from its mouth.

A. A.

The earliest mention of the term yet discovered is in 1365, 39 and 40 Edward III; "To John Wytcliff for 22 dol. [blocks? or tons] of Bere stone, bought 'pro tabulamentis et gargol'—entablatures and gargols (or gargles) of the new tower", BRAYLEY and BRITTON, *Palace of Westm.*, 8vo., London, 1836, 187. LYDGATE, *Book of Troye*, cir. 1430 (Marshall's edit. 1555), B. ii, sig. Fv, ver., notes the use of down pipes as an unusual practice, though they were employed at the Tower of London as early as 1241 (Lib. Roll, 25 Henry III); thus,

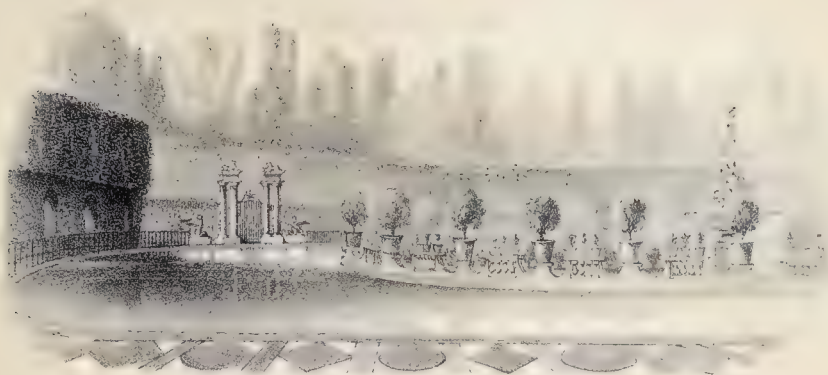
"And every house couered was with lead,
And many gargyle and many hydrous head,
With spoutes thorough and pipes as they aught,
From the stone worke to the canell raught."

WILLIAM OF WYRCESTRE (Nasmith's edit., 282) uses 'gargayle', cir. 1480. SURTEES SOCIETY, *The Fabrick Rolls of York Cathedral*, 8vo., Durham, 1859, p. 88, has in 1485, "xxxij gargilles, unum les gargill ad 12d." An edict of the police 13 July 1764 prevented the future use of gargoyles in Paris; DALY, *Revue Générale*, iv, 51-9: and the Statute 22 Car. II, c. 11, 1670, ordains the use of pipes down the sides of houses in London.

WITHERS, *Dict.*, 1568, 40; 1608, 163, has "gargels of men's

GARDEN

Fig 1



Figs 1 & 2
Plan and View of
L'ISOLA BELLA



Fig 2

on the BOBOLI GARDENS
FLORENCE

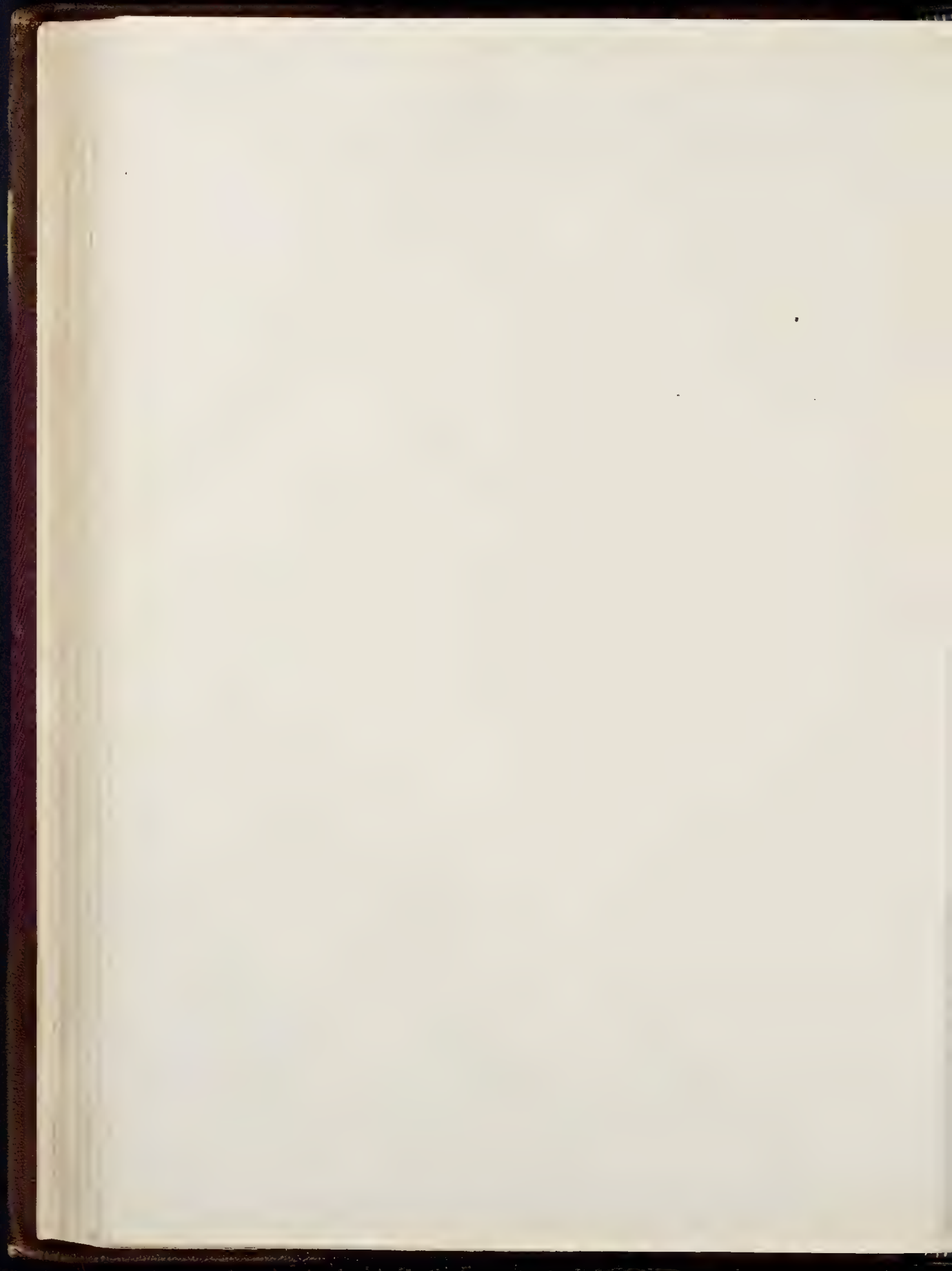
Scale of Feet

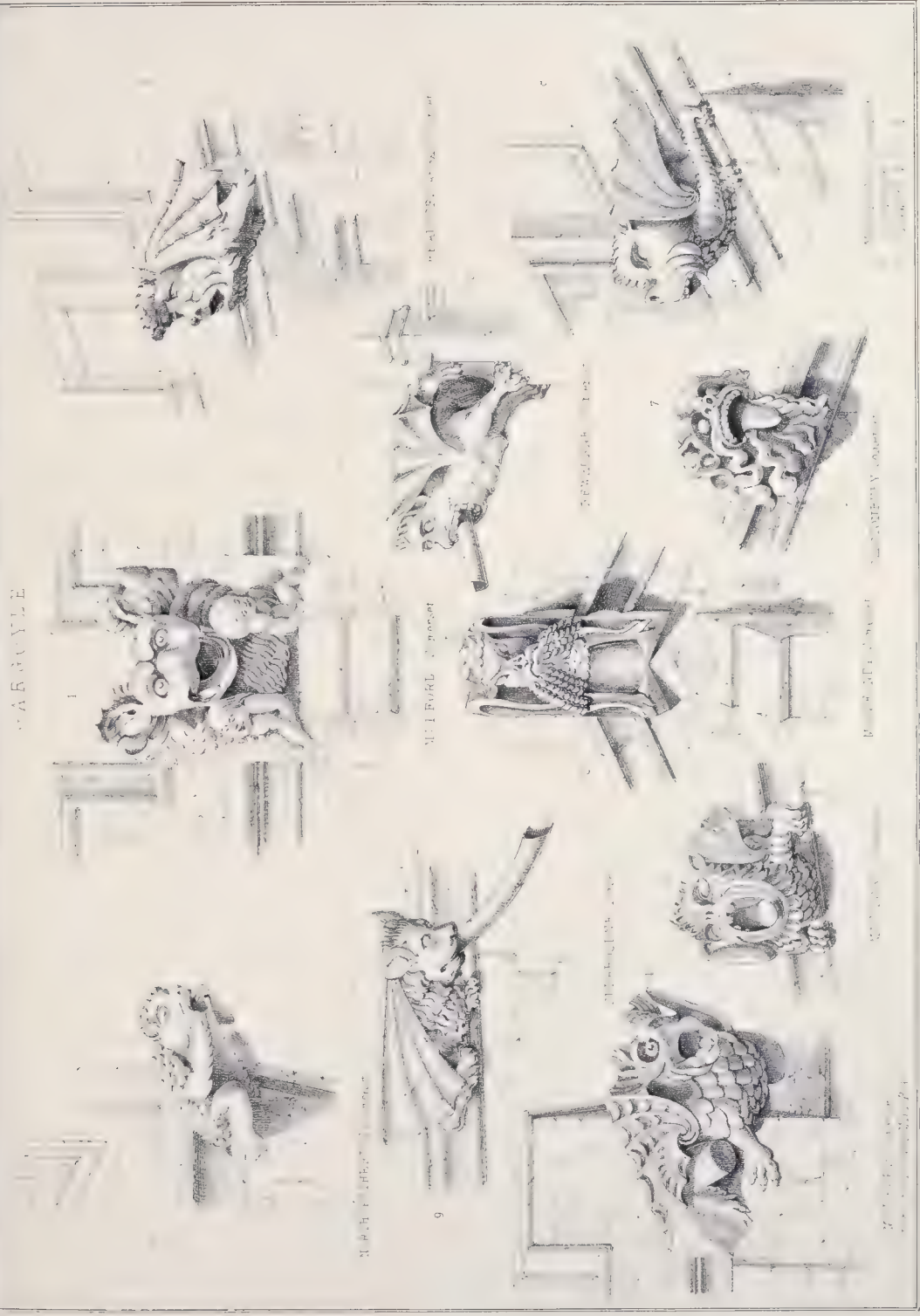
Fig. 3.



MONREALE

London: J. & J. Smith, 1841.





CARVING



figure, Telamones, Atlantes"; and "gargels of women's figure, Cariatides"; HORMANUS, *Vulgaria*, 4to., 1519, says "make me a trusse stadyng out vpon gargellys (*mutulos*) that I may se about"; and "I wyll haue gargyllis (*mutulos*) vnder the beamys heedis", fol. 241-2; all in mistake of the meaning of the word. The PROMPT. PARV., 1499 (WAY's edit. 1843), has "gargulye yn a walle, *gorgona, gurgulis*"; and PALSGRAVE, *Eclaircissement*, 1530, "gargyle in a wall, *gargoille*". The word does not appear to have been in use during the early part of this century; DUDLEY, *Natology*, 8vo., Leicester, 1846, 565, has the curious line "gurgoyles, alias gathercoles", adding, p. 567, "these may have been intended—to counteract and prevent the mischiefs that it was imagined might befall the sacred fabric from fascination by an evil or malignant eye." 16. 17.

Examples will be found in *Illustrations*, 1859; TAYLOR and NODIER, *Voy. Pitt.* (Champagne), fol., Paris, 1843-5; three plates from Rheims cathedral; and one from Notre Dame de l'Épine at Chalons. CORBEL; GARLET; LION'S HEAD; SPOUT; SYMBOLICAL STATUE.

GARDEROBE. The French name, from which the English wardrobe is derived, for the place where dresses, linen, etc., are stored. A fireplace and vicinity to bedrooms seem to be the only requirements for a garderobe in French plans. When the euphuism of the eighteenth century became ashamed of the term *lieu à l'Anglois*, the usual proximity of the closets suggested the expression *garderobe d'aisance*, which, shortened into *garderobe*, still means a closet with a supply of water. DRAUGHT; LATRINA; PRIVY; WATER CLOSET.

GARE (JUAN) is noticed as *mestre en pedreria* and master of the works of the collegiate church of Sta. Maria, which he built 1387-93 at Oliveira in Portugal, in the style of that at Batalha. 66.

GARLAND, in Decoration, see WREATH.

GARNET or CROSS GARNETS. The name of a hinge of a T shape, whence it is called a 'T hinge' in some localities. Among London ironmongers, the word 'cross-garnets' is used as a trade term to define T joints of the worst quality and workmanship; the best quality of T joints is known in the London trade as 'London T joints, best Lancashire', and they are generally used for hanging ordinary ledged doors. In the country, the definition is somewhat the reverse of this, as the word 'cross-garnets' is there used to denote the best and heaviest quality of T joints as are most suitable for hanging heavy gates and doors. For cellar flaps, covers to areas and bins, and other horizontal doors exposed to the weather, WATER JOINT HINGES are preferred, as from the construction of the knuckle, which is like two links of a chain, or one ring moving within another, the working parts are not likely to get set fast by rusting.

The following is a table of the usual sizes and weights of 'Winlton cross-garnets', which are the best made; the same numbers, sizes, and weights, equally apply to 'Winlton hooks and bands', or 'hooks and hinges'. R. R. R.

| Trade Numbers | Weight per Pair in Pounds | Length in Inches. |
|---------------|---------------------------|-------------------|
| 00 | 3½ | 15 |
| 1 | 4 | 16 |
| 2 | 4½ | 17 |
| 3 | 6 | 19 |
| 4 | 7½ | 21 |
| 5 | 9 | 24 |
| 6 | 11 | 27 |
| 7 | 14 | 30 |
| 8 | 17 | 33 |
| | 21 | 36 |

The term is found in 39 and 40 Edward III, 1365, "pro—1 par' garnettor"—"pro garnett' et viroll. of iron tinned"—"six pair of garnetts"—; and "a pair of gernetts", is mentioned as early as 26 Edward III by SMITH, *Antiq. of Westm.*, 4to., Lond., 1807, 206; BRAYLEY, *Palace of Westm.*, 8vo., Lond., 1836, 192. The following is a later use of the term: "That

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pentises and jetties be at least the height of nine feet, and that the stalls be not but of two foot and a half in breadth, and to be flexible and moveable, viz., to hang by jewmews or garnets, so that they may be taken up and let down"; HOWEL, *Londinopolis*, fol., London, 1657, 393. CHYMOL; GEMELLE; JEWMEW.

GARNIER (JEAN CHARLES), seigneur d'Isle, whence he is sometimes called Garnier Dille, and sometimes simply Dille, son-in-law of Desgots according to BLONDEL, *Arch. Franç.*, fol., Paris, 1752, i, 238, was elected 1724 a member of the Academy of Architecture at Paris; and became architecte et contrôleur des bâtiments du roi. He designed the gardens of the château of Crecy near Dreux; and of the château of Bellevue at Paris. He died 12 December 1755, aged 58. 45.

GARRET (Sp. *desvan*; Fr. *galeas*). The uppermost story of a house, obtained within the roof, and frequently left open to the rafters; it was formerly used as a store room; whence in publications of about 1650 the height of the garret is stated at from 6 to 9 ft.: it is still in use as a bed room. The space between the ridge and the ceiling is usually called a cock-loft. ATTIC.

GARRET LOCK. The term applied to locks of the most inferior description, because they are made by men of small means who live and work in garrets. R. R. R.

GARRETTA or GARETTA (Sp. *garita*; Fr. *guirite*). A mediæval term for a turret on the battlements of a house or castle to afford protection to a soldier. The term occurs in PARKER, *Dom. Arch.*, 8vo., London, 1853, ii, 205, "There are other rooms in the projecting turrets (or garrites) of which there are four, one being square, and the other three round." Various parts of the walls of the Tower of London were in the 23 Henry VIII ordered to be "copsyde, lowpyd, garretyd, and crestyd" by the mason, whence small turrets have been presumed to be intended; BAYLEY, *History of the Tower*, 4to., London, 1821, pt. 1, app. ix. But battlements are meant in RISDON, *Survey of Devon*, 8vo., London, 1811, p. 202-6, speaking of a castle—"garreted with turrets at every corner"; and, "castle-like, with round turrets at each end garreted at the top", according to lexicons of the last century. 19.

GARRETTING, see GALLET.

GARRON NAIL, see DOUBLE GARRON NAIL.

GARTH. An old term, for a small enclosure adjoining to a building, often used in connection with other words, as centry or cemetery garth, cloister garth, garth house, etc.

GARTH STONE. The conglomerate or millstone grit beds at the base of the carboniferous series of the Ruabon district, in the county of Denbighshire, yield at the entrance of the vale of Llangollen a building stone, which was formerly used in the construction of the bridge over the Dee at Llangollen (cir. 1346); and of Vale Crucis abbey, the older parts of which date from about 1200. A similar stone has lately been raised upon the estate of G. H. Whalley, Esq., M.P., and introduced under the name of Garthstone. Geologically and lithologically, Garth stone is precisely the same as the stone used in the buildings above named; and local tradition would seem to indicate that the supplies for those buildings were actually obtained from the Garth quarries. The singular sharpness of outline of the details of Vale Crucis abbey, and of the moldings of Llangollen bridge, prove that this stone possesses great powers of resistance to atmospheric agents. Upon the suppression of the monastery about 1538, the roof and the whole of the internal fittings were destroyed by fire, of which the carving of the capitals, the tracery, and the bosses of the fallen vaulting, retain traces to the present day, in the discoloration of their surfaces; but they are otherwise intact; and fire may be considered to have little influence on the stone. Llangollen bridge is every winter washed by the floods of the Dee, and sometimes entirely covered by them; but water seems to have as little effect as has fire on this stone.

Garth stone can be furnished in large ashlar blocks, or in

small rubble for random or for coursed masonry. It is of about the same specific gravity and hardness as Bramley Fall stone; and the labour on it would be about equal to that of the Bramley Fall, whilst its resistance to crushing or to transverse strains may be considered to be equal to those of the same standard. There are no recorded experiments, however, on the subject. The Garth quarries are situated in the immediate vicinity of the Ellesmere canal, and of the Ruabon extensions of the Great Western system of railways; so that it is believed that the stone could be delivered in London at even a less price than Portland stone.

One peculiarity about the Garth stone requires to be noticed; namely, that, although very dense, it possesses great powers of absorption, on account of the capillary action of the particles of the conglomerated silica. It would, therefore, be necessary in some descriptions of building operations to adopt precautions in order to prevent the ascension of water through the stone, if the latter were immersed in water, or were in a position to absorb moisture from surrounding bodies. Alternations of dryness and humidity do not, however, appear to affect the durability of the stone. Its colour is a greyish white, with shining facets of rock crystal and mica. In the vale of Llangollen, exposure to the weather for centuries has produced little alteration in the original colour of the supposed Garth stone.

G. R. B.
GARZIA D'EMERE, see EMERE.

GARZIA (ALVARO), see GARCIA of Estella (ALVAR).

GARZONOSTASIUM. This term is explained by CALEPINUS, *Dict.*, as the place in mediâ aulâ of the church of Sta. Sophia at Constantinople where the boys stood. BATISSIER, *Hist.*, says that Theophanes and Cedrenus use it for the atrium in front of the church.

GAS. The use of coal gas for the purposes of domestic illumination is essentially a modern invention, for it was only in 1792 that William Murdoch so far perfected the method of extracting inflammable gas from coal as to be enabled to light his own house at Redruth, Cornwall, with it. In 1798 he lighted Messrs. Boulton and Watt's factory at Soho near Birmingham; in 1807 the Jesuits' college at Stonyhurst was lighted, under the directions of Mr. Clegg; it was used in the same year in some of the lamps in Pall Mall by Mr. Winsor; in 1810 the first gas company was established; in 1814 the parish of S. Margaret, Westminster, substituted gas for oil; and since that period its use has become universal throughout the civilized world. Coal gas is usually stated to be a carburetted hydrogen; but, even after the most careful purification, it contains variable proportions of sulphuretted hydrogen, carbonic oxide, bisulphide of carbon, and of ammonia. It is obtained by heating coal, or other substances containing the hydro-carbons, in closed vessels or retorts (of cast iron or of clay) heated to a temperature, varying according to the nature of the raw material used, from a red to a white heat. The gases liberated from the coal in these retorts are conveyed from them to condensers, scrubbers, purifiers, station meters, and finally to the holder, from which the distribution to the points of consumption is ultimately effected.

Small gas works, for lighting mansions, factories, etc., in outlying districts, have lately been perfected to such an extent as to justify their frequent use; it is desirable, therefore, to allude to the considerations which ought to be taken into account before the erection of such works is determined. The eligibility of adopting gas in lieu of other ordinary lights in private houses in the country, where no town supply is near, depends 1, on the number of lights required; 2, on the price of fuel on the spot. Whenever gas can be procured at a rate of less than about six shillings per thousand cubic feet from a gas company's works, it is hardly desirable to establish private works, unless there should be at least a hundred or a hundred and fifty lights required. There is no doubt that in these small works the cost of the manufacture does not, as a general rule, exceed four shillings per thousand; but there are so many

annoyances connected with the manufacture, and it requires skilled labour of so special a description, that unless the gas factory be worked in connection with a fixed steam engine, and at some distance from the mansion, its disadvantages are almost insurmountable. Moreover, the process of condensation, purification, and storage cannot be performed satisfactorily on a small scale; and the occasional stoppage of the works entails such an amount of inconvenience as to justify the preference of the 'commercial' over what may be called the 'home made' gas. When stored over water for any length of time, coal gas deteriorates in quality; and it must therefore always be an object, in designing any small house works, to make the producing power of the retorts proportionate to the consumption of each day.

On the various points connected with this subject and the following articles, further details will be found in ACCUM, *Practical Treatise on Gas Lighting*, 8vo., 1815; PECKSTON, *Theory and Practice of Gas Lighting*, 8vo., 1823; D'HURCOURT, *De l'éclairage au Gaz*, 8vo., 1845; CLEGG, *Practical Treatise on the Manufacture of Gas*, 3rd edit., 4to., 1859; and *The Chemistry of Gas Lighting*, extracted from the JOURNAL OF GAS LIGHTING, 8vo., 1860; the articles on this subject in URE, *Dictionary of Arts and Manufactures*; KNIGHT, *English Encyclopædia*; SCHILLING, *Handbuch für Steinkohlengas Beleuchtung*, 4to., Munich, 1860; the JOURNAL OF GAS LIGHTING; the AMERICAN JOURNAL OF GAS LIGHTING; LE GAZ; LE JOURNAL DE L'ÉCLAIRAGE AU GAZ; DAS JOURNAL FÜR GAZBELEUCHTUNG; *Report and Evidence* given before a Committee on the Great Central Gas Consumers' Bill, 1850; the *BUILDER Journal*; BROWN, *Instructions to Gas Consumers*, 8vo., 1852; and the various Encyclopædias.

G. R. B.
GAS (DISTRIBUTION OF). The distribution is effected through cast iron pipes with sockets and spigot ends, whenever the diameter exceeds 2 ins.; for pipes of smaller diameters and house services, wrought iron, tin, and composition, are used. For occasional use, flexible pipes are employed, such as those made of gutta percha, caoutchouc, with or without a wire coil inside, and caoutchouc coated with varnish. The various formulae for calculating the velocity and the pressure of the effluent gas are to be found in CLEGG, *Treatise on Gas Lighting*: the most economical working pressure is equivalent to the weight of a column of water on the outlet, of about 1 inch. The formula

for calculating the quantity discharged is $q = 1350 d^2 \sqrt{\frac{h d}{s l}}$;

in which q = the quantity sought in cubic feet per hour; d , the diameter of the pipe; h , the working pressure in inches; l , the length of the pipe in yards; and s , the specific gravity of the gas compared with atmospheric air as unity. The following table represents the delivery per hour through pipes of the diameters named.

| Size, diam. | Thickness | Length. | Wght. | Delivery. | Cost of Laying. |
|----------------|---------------|---------|---------------|-----------|---|
| ins. | | | | cubic ft. | |
| $\frac{1}{2}$ | | | | 90 | |
| $\frac{3}{4}$ | | | | 160 | |
| 1 | | | | 250 | |
| $1\frac{1}{4}$ | | | | 350 | |
| | wrought iron. | | | | See Lockwood's Price Book, 1862, art. Gas Fitter. |
| | inch. | feet. | cwt. qr. lbs. | | s. d. |
| 2 | 6-16ths | 6 | 0 1 24 | 2,000 | 1 13 |
| 3 | 11-32nds | 6 | 1 0 3 | 4,500 | 1 13 |
| 4 | 3-8ths | 9 | 1 1 24 | 8,000 | 1 13 |
| 5 | 13-32nds | 9 | 1 3 24 | 12,500 | 1 8 |
| 6 | 7-16ths | 9 | 2 2 2 | 18,000 | 1 8 |
| 7 | 15-32nds | 9 | 3 0 14 | 24,500 | 2 6½ |
| 8 | 1-half | 9 | 3 3 5 | 32,000 | 2 6½ |
| 9 | 17-32nds | 9 | 4 2 2 | 40,500 | 3 0 |
| 10 | 9-16ths | 9 | 5 1 6 | 50,000 | 3 0 |
| 12 | 5-8ths | 9 | 7 0 5 | 72,000 | 3 7 |

In regulating the distribution of gas, it is essential to observe that any sensible increase of elevation, by diminishing the resistance to the escape of the gas at the burner, practically increases the velocity of discharge; hence it may be necessary to introduce 'governors' in the higher localities of a town. All abrupt bends, curves, or changes of direction, either hori-

zontal or vertical, check the flow of the gas, and should therefore, if possible, be avoided. The connections between house distribution and street mains require to be made with extreme care; stop-cocks on the house services should be inserted, wherever it is possible, outside the house, and the meters and regulators should be placed near to some external opening, and as close to the main as possible. The meter should be placed a little above the level of the street main, and the distributing pipe in the interior should start from the upper part of the meter rising gradually from it, so as to prevent any water from the meter or any water of condensation passing into the pipe. Wherever, in fact, a main or a distributing pipe falls below the horizontal line, a dip-pipe with a tap must be inserted, to collect and draw off the water which will eventually collect in it; it is to such an accumulation that the disagreeable flickering of gas lights is usually to be attributed. The meter, street junction, and primary distributing pipes, should always be easily accessible for examination and repair, but placed out of the way of being tampered with; good ventilation should be provided around the meter.

In the details of house fittings, wrought iron pipes should be used whenever the diameter exceeds half an inch ($\frac{1}{2}$ in. is the least size sometimes recommended, even for supplying upper rooms); and it is preferable to use that material, even at the risk of employing diameters in excess of those required to deliver the gas, rather than to resort to the use of other metals. For pipes of smaller diameters, and where abrupt bends have to be made, either composition or tin are used; but great care is required in the selection of the former. Under no circumstances whatever should either iron or composition pipes be let into the plastering, as is too constantly done, or into solid brick or stonework; for the salts in the latter are liable to affect the pipes in a serious manner, and the contraction and expansion of their materials may injure the joints; whilst it must always be difficult to trace a leakage, should one occur in a pipe buried in a wall. The police regulations of Paris require that gas pipes in houses should be visible throughout their length, excepting where they traverse floors, partitions, etc., when the pipe conveying the gas is required to be enclosed in a larger one, projecting beyond the floor or partition, so as to ensure ventilation round it. Copper pipes should never be used; after a short time a detonating substance is formed in their interior by the action of the gas on the metal. G. R. B.

GAS BURNER. The form of burner which yields the best economical results is the argand; the bat's wing is the next best; and the fish tail is the worst; but it must be observed that the description of glass shade used has an important influence on the useful quantity of the light produced—some of the ground glass globes, in fact, annihilate as much as 60 per cent. of the illuminating power of the gas. As the effect of artificial light diminishes as the square of the distance of the flame from the point of observation, it is desirable to diffuse the sources of light as much as possible in a room; thus a number of small burners dispersed, will give a better light than collections of them. For lighting large rooms, however, where it is not necessary to throw the light upon a particular space, the so-called solar or 'sun light' arrangement is very agreeable; and as it may easily be made to serve as a means of artificial ventilation, it is free from some of the defects of ordinary gas lamps; but it is very costly, both in its first establishment, and in the subsequent consumption of gas. In rooms of moderate height, the use of sun lights is objectionable on account of the heat acting on the heads of the occupants.

It is essential that the escape of the gas should be regular, and effected by large openings in the burner with small pressure; the burner should be made so as to ensure the perfect combustion of the gas in the prescribed quantity when it is 'full open', and the gas escapes with its due velocity. If the latter should be increased, the velocity of the efflux will also be increased, and a portion of the gas will escape uncon-

sumed; forming smoke around the flame, and sometimes also producing a very disagreeable noise. In large towns this proportionate efflux can only be obtained by the use of regulators placed on the inside of the meter: hitherto Hulet's mercurial regulator appears to be the most successful instrument of the kind in use. To trust to the use of the stop-cock to regulate the flow of gas, is utterly in vain; both from the neglect of servants, and from the consumption of the gas being imperfect. In London the gas in the day time is rarely under more than 1 in. pressure; at sunset the pressure rises to about $2\frac{1}{2}$ or 3 ins.; about eight o'clock in the evening it may be even 4 ins.; at ten o'clock it falls again, and after midnight it will not exceed $1\frac{1}{2}$ in. Unless, therefore, regulators be used, or the size of the flame be very narrowly watched, smoked ceilings must be the result. The internal diameters of the fittings must be made with sufficient accuracy to produce as small an interference as possible with the flow of the gas.

The illuminating power of gas is ascertained by comparing the light produced by a burner consuming a certain quantity in a given time, with that of a recognized standard. In England the one usually adopted is the sperm candle, burning 120 grains per hour; in France the carcel oil lamp is used. Ordinary Newcastle coal will yield a gas equivalent in photometric power to ten or twelve candles; when cannel coal is used, the value of the light rises to sixteen or even to eighteen candles; and when the Boghead coal is used the value rises to twenty or twenty-two. Of course, light for light, the richer gas gives off the least heat, and the smallest quantity of injurious products of combustion; but its cost renders its use out of the question. The prime cost of Boghead coal is, at the quay side, about eight or nine times that of common coal; and the residual products are at present worthless.

An ordinary argand burner with fifteen holes will burn about $5\frac{1}{2}$ to 8 ft. an hour, according to the pressure; ordinary street lamps of the bat's wing form consume from 3 to 8 ft. per hour, and are usually contracted for at the rate of $5\frac{1}{2}$ ft.; the other kinds of burner may be made to suit any required rate of consumption. In streets, lamp posts are usually placed on the edges of the kerb stones, at alternate distances of about 66 ft. on either side of the road; but in less frequented parts of the town this distance may be increased. For ordinary purposes, a fifteen hole argand burner will suffice to light a room measuring about 3,200 cubic ft., if the wall hangings are tolerably light; but it would only be possible to write in such a room, when close to the lamp. G. R. B.

GAS (EFFECTS OF). The urgency of efficient ventilation when gas is burnt habitually, is remarked upon hereafter under GAS (NOXIOUS). It is principally to the neglect of this precaution that the bulk of the injurious effects said to attend the use of gas may indeed be attributed: and in the case of libraries, the destruction of the book bindings may be assigned more justly to the heat than to the chemical action of the products of combustion. No doubt the bisulphide of carbon, which is present in even the most carefully purified gases, must give rise to the formation of minute quantities of sulphurous acid; and this, in its turn, must be destructive to some descriptions of leather—especially Russian (as noticed in *BUILDER Journal*, 1848, vi, 89); but a rapid removal of the products of combustion would almost entirely obviate this effect. It seems, however, that the excessive dryness and the heat of the air in the upper part of the rooms where gas is burnt, may occasion the injury quite as much as the chemical reactions supposed to take place; the books which suffer most being always those placed above the level of the lamps; under any circumstances it should be laid down as a law that the ventilation should take place close to the plane of the ceilings. Even when provision is made for ventilation over gas burners, a stratum of heated air is often allowed to stagnate over the openings, close under the line of the ceiling; and the area of the openings is rarely sufficient to allow the escape of the decomposed gases. Again, if any sulphurous acid should

be produced, it will be found also to tarnish the colours of tapestry and hangings, and to turn imitation gold; hence none but the best leaf-gold should be employed in rooms where gas is burnt. The injury caused by the use of such gas as is supplied in London, Paris, Bruxelles, etc., is very small compared with the brilliance of the light; and the gas of Liverpool, Edinburgh, Manchester, and some other places having, bulk for bulk, a higher illuminating power than that of London, is even less injurious. SPENCER has reported that the quantity of gas leaking from London gas pipes is not less than 9 per cent., or between six and seven million cubic feet per annum, which causes the stinking black earth of the London street subsoil: and that no such leakage occurs at Liverpool or Manchester, where the joints of the pipes are bored, turned, and fitted to each other like ground stoppers in glass bottles; whereas in London the pipes are jointed with tow and lead, so that after expansion and contraction in summer and winter the perfection of the joint is destroyed. The gas then acting upon the subsoil forms sulphuretted carbon, which corrodes not only the gas pipes, but the water mains also, and converts them in ten years almost entirely into a sort of plumbago, although in pure London subsoil they last a century; *BUILDER Journal*, 1860, xix, 334, from *Report to the New River Company*, etc.

It may be desirable to add that the presence of sulphuretted hydrogen may be detected by causing a jet of the gas to blow upon a piece of white paper immersed in the acetate of lead; the paper will at once be discoloured if sulphuretted hydrogen be present. Carbonic acid may be detected by causing the gas to rise through a clear solution of the hydrate of lime; if this impurity be present, the solution will become turbid. If ammonia should be present, it will be detected by causing a jet to blow against a piece of turmeric paper, when the ammonia will turn the yellow of the paper to a reddish brown. The presence of the bisulphide of carbon is ascertained by condensing the aqueous vapour produced by the combustion of the gas, and by presenting litmus paper to the resulting product, when it would be reddened if the bisulphide be present. G. R. B.

GAS FITTINGS. In addition to what has been said on the burners, it may be stated that they are affixed to pendants, brackets, or pillars, accordingly as they are required to be used as suspended or as standard lights. With these necessities arranged, the architect may proceed to dictate the artistic details of the outline of the bearers, and the distribution of the light; the general principles to be laid down are that they should be rendered as consistent in outline, colour, and position, with reference to the other decorations of a room, as possible. As to the distribution of the light, the principle before cited of using a number of small burners dispersed over the room, rather than a concentration of burners, is greatly to be recommended. In dining rooms, however, of small houses, central chandeliers give the most agreeable light; but in large dining rooms lights upon the walls are the most pleasant, unless the width be so great as to require central lights in addition. In churches pillar lights are most generally adopted, and they are the most agreeable, as well as the most economical.

Central and suspended lights are either grouped in gasaliers, or they are made as 'harp, swing, or bracket' lamps. Harp lamps have usually single argand burners with a bell shade over; swing and bracket lamps are usually formed of straight pipes of a \perp or a L shape, with either argand or fish-tail burners, with bell shades over if desired. Gas chandeliers are usually made with argand burners, hydraulic joints, and counterpoises allowing them to be lowered at will, and are often of such great weight as to require special framing to support them; the escape of gas from these joints is always to be feared, as whistles even when applied may not be heard. Solar and stellar lights are usually composed of collections of fish-tailed burners, placed at right angles to descending pipes, and surrounded by a double case serving the purposes of spreading the flames and reflecting the light, whilst it also promotes ventilation.

A notice was issued January 1862 from the London Fire Engine Establishment, stating that "It appears absolutely necessary that some steps should be taken to caution owners of property, particularly in large wharves and warehouses, as to the position and protection of the dangerous gas lights. These remarks may not be considered unnecessary when it is remembered that in many of the most valuable buildings in the metropolis movable gas brackets are placed within 20 ins. of the ceiling without the slightest protection whatever. It may be laid down as a rule that the jet on the outer arm of the bracket should never be less than 36 ins. from the ceiling over it, and that it should be protected on the top by a hanging shade, and on the sides by stops on the swivel joints, which should prevent the brackets moving beyond a safe distance. Attention might, perhaps, also be called to the very common and dangerous practice of nailing tin or iron on the adjoining timbers. This has long proved to be no protection, and it has the disadvantage of allowing the timber to be charred completely through before it is known." In some places gas lights are used within 15 ins. of the ceiling, and when the shade has broken away and not been replaced, the heat has been known to ignite the floor timbers over the plastering.

As illustrations of the mode of lighting public buildings may be cited, 1, the concert room of Liverpool, designed and executed by Mr. A. King; it is effected principally by carrying a pipe in the cove of the ceiling, which pipe is pierced with numerous holes for fish-tail burners: 2, the S. James's Hall, London, and the great hall of the Reform Club, which are admirable illustrations of the use of the stellar and of the solar lights: 3, the new theatre du Chatelet at Paris, where the lighting is effected by 1,300 burners placed above a vault of ground glass, and under a large enamelled reflector; the glass vault forms, in fact, the ceiling of the body of the house, so that the burners themselves are entirely hid; this arrangement was also employed for a few years at the gallery in Suffolk-street, London: and 4, the various passages and rooms of the Houses of Parliament, which are lighted and ventilated under Faraday's principle.

It will not be necessary here to do more than mention the use of gas in the kitchen for boiling water, or for baking and roasting; the value of baths heated by gas, so readily adaptable in places where a coal stove cannot be used; or the several gas stoves for warming buildings and rooms. G. R. B.

GAS METER. An instrument used for measuring the consumption of gas. There are two descriptions; the wet, and the dry, meter. The wet meter consists of a wrought iron drum, working freely in water standing at a level slightly higher than that of the axle, and consisting of four or five divisions or arms: the gas is introduced into one of the chambers thus formed, and acts by its elasticity on the surfaces of the water and of the partition, and causes the latter to advance, when the gas escapes into an outer chamber connected with the outlet pipe. The revolution of the drum acts on a series of wheels gearing into one another, which move the index. In order to secure regularity of working, the level of the water must be kept permanent, for which purpose the level of the inlet should not project much above the normal water line, whilst the overflow must be rigorously adapted to the same level, and the float cut off the passage of the gas directly the water in the meter falls below a certain level. In fact, when the meter has too much water, it 'tells' against the consumer; when too little, it 'tells' against the supplier; hence it is desirable to employ self-regulating meters, such as Crossley's, Edge's, Sanders's, Clegg's, etc.

In the dry meter, the gas is admitted alternately into chambers of definite capacities; when one of them is filled the passage of the gas is transferred to the other chamber, and the outlet from the filled one is opened; the movement to the train of wheels is given by the alternate motion of the faces of the chambers. The objection to the use of the dry meter is that

the leather which forms the movable part of the chamber decays under the action of the gas, and allows it to pass without being registered, whilst the friction of the machinery is greater than that of the wet meter. In Croll's dry meter these objections have been practically overcome; yet the wet meters of the best description furnish more reliable indications of the actual consumption. The action of frost on wet meters may be counteracted by the addition of a little alcohol to the water. The best gas meters always exercise an effort equal to about one-tenth of an inch of water, on account of their momentum and of their friction.

Under the Sale of Gas Act, 22 and 23 Vict. cap. 66, amended by 23 and 24 Vict. cap. 146; and the Metropolis Gas Amendment Act, 24 and 25 Vict. cap. 79, which came into operation on the 14 October 1861, it is enacted, under a penalty of £5, that no meter shall be fixed in the metropolis and all counties and boroughs which have adopted the act, unless first tested and stamped as correct by an inspector appointed under the act.

G. R. B.

GAS (NOXIOUS). In addition to what has been already stated in the article **FOUL AIR**, it may be necessary to add a few remarks upon those gases whose action is capable of rendering air prejudicial, and in some cases fatal, to animal life. The specific gravities of such gases may be stated as follows, quoting mainly the tables of the *Annuaire du Bureau des Longitudes*, but taking as the unity of comparison atmospheric air = 1000; then hydrogen = 6926; carburetted hydrogen, or marsh miasma, 555; nitrogenous miasmata about 976; elefant gas 978; sulphuretted hydrogen 1178; carbonic oxide 957; sulphurous acid, when anhydrous, 3000; common coal gas ranges between 514 and 420. All these specific gravities, however, refer to the composition of the atmosphere at the standard temperature, or at 60° Fahr., and under a pressure equal to 30 ins. of mercury. Above or below that temperature, or that pressure, the conditions of diffusion of gases vary in a very marked manner; and it is on this account that the foul air of sewers, cesspools, etc., exercises a more extended action laterally in hot weather, when it is able to diffuse itself more easily through an attenuated atmosphere than in cold weather, when the greater density of the atmosphere, and the comparatively speaking higher temperature of the gases given off from the covered receptacles mentioned, enables the foul air to rise vertically with greater ease than to spread laterally. Again, in the act of respiration, human beings absorb oxygen and emit carbonic acid gas; artificial lights also consume oxygen, and evolve either carbonic acid or oxide of carbon. Of these gases, the carbonic acid, being of greater specific gravity than atmospheric air, would, at the ordinary temperature of the air, tend to accumulate in its lower strata; but the temperature of the products of respiration and of combustion is usually so much in excess of that of the air, that they are enabled to rise through it, and to accumulate in the upper portions of an enclosed room until some change in their temperature takes place.

When the quantity of oxygen in the atmosphere is reduced from 20 to 16 per cent., a candle would be extinguished; 4 per cent. of carbonic acid gas will produce suffocation, especially as that quantity can only exist concurrently with an excess of nitrogen. Carburetted hydrogen gas, in the form in which it occurs in mines and underground workings, is more dangerous on account of its explosive nature than of its effects on the human constitution; the architect may occasionally have to guard against the possibility of its production in coal cellars or coal stores; sometimes, also, this gas is met with in rooms, or in cellars, in which fermentation is going on.

Sulphuretted hydrogen gas, the foul air most commonly met in sewers and cesspools, is said to produce in time injurious effects upon the human constitution when it is present in the proportions of about 1 of the gas in 15,000 of atmospheric air; whilst 1 in 1500 is known to be fatal to birds, and 1 in 250 to horses. It explodes at a lower temperature than carbu-

retted hydrogen; and, indeed, in this respect it is nearly as dangerous as ordinary coal gas. The sulphuretted hydrogen exercises marked effects upon paints with a base of oxide of lead, and upon the commoner descriptions of gilding, brass works, etc., which it tarnishes and blackens with rapidity. The specific gravity of this gas is so near to that of common air, that very slight changes in the relative temperatures of those fluids may allow the former to diffuse itself; and it almost always happens that the chemical decompositions which produce the evolution of sulphuretted hydrogen are accompanied by an evolution of heat, which diminishes the density of that gas to such an extent as to allow of its temporary diffusion. Fortunately the smell of this gas is so extremely unpleasant (it is very like, and indeed is the same as, the smell of rotten eggs) that it almost enforces its own police.

Sulphurous acid gas is principally produced by the combustion, or the decomposition, of materials containing sulphur in combination. The spontaneous decomposition of the sulphuret and the sulphate of iron, to be met with in coals, is an occasional source of inconvenience, and even of fire.

In some cases, as in the urinals, etc., of railway stations, the air is rendered foul by the presence of ammoniacal gases of a very pungent character, all of which are of lesser specific gravity than that of atmospheric air, even at ordinary temperatures. Nothing but a profuse use of water, and a most energetic ventilation, can obviate the effects of these gases; but perhaps they may be considered rather to be disagreeable than fatal, for men employed in tanneries work for years in atmospheres highly charged with these ammoniacal gases; it is true, however, that they are not a long lived class of men, nor are they physically strong.

Air rendered foul by the escape of coal (or common lighting) gas, is more likely to prove dangerous from its explosive properties than on account of its action on the human constitution. In consequence of its light specific gravity, this gas rises in closed rooms and tends to accumulate near the ceiling; so that the upper atmosphere of a room in which gas may be escaping may be in a very explosive condition, whilst the lower atmosphere may be nearly free from danger. Where gas is burnt, a very powerful ventilation must be established immediately underneath the ceiling; the combustion of coal gas tends likewise to render air foul by the absorption of oxygen; and it must always be borne in mind that every description of artificial light produces the same effect in the direct ratio of its brilliancy.

The aqueous vapour in suspension in the atmosphere is not directly a source of danger to the majority of human beings exposed to its effects: though of course it must be considered to be a source of very unpleasant sensations, which may injuriously affect some constitutions. Its presence is, however, indirectly capable of rendering air foul; for in the first place an abnormal quantity of aqueous vapour so present enables other gases to rise, on account of the increased density of the air; and in the second place, it enables decomposition to take place in the substances with which it is brought in contact, but this part of the inquiry would be more conveniently discussed under **MOISTURE**. **VENTILATION.**

Gmelin, *Handbook of Chemistry*, transl. by Watts, 8vo., London, 1848; Ure, *Dictionary of the Arts*, 5th edit., 1859; Brande, *Manual of Chemistry*, 6th edit., 8vo., London, 1848; Bunsen, *Gasometry*, translated by Roscoe, 8vo., London, 1857. **THE USEFUL METALS AND THEIR ALLOYS.** G. R. B.

GASCÓ (VICENTE), born 1734 at Valencia, was educated for the church, but, on the death of his father Salvador, a *maestro de obras*, he applied himself to architecture to support the family, and was appointed surveyor of the roads, in which capacity and as architect he executed, besides the bridge at Cullera, and that at Catarroja, many works in Valencia and its neighbourhood, among which the chapel of the monastery of N. S. del Carme in that city was highly praised. To these

works and his pupils in the academies of Sta. Barbara and of S. Carlos, as well as in the school of the Junta Preparatoria in that city, he owed the reputation of being the restorer of architecture in the kingdom. He became 7 February 1762 *académico de mérito* in the Royal Academy of S. Ferdinand at Madrid; and was a corresponding member of the Imperial Academy of Fine Arts at S. Petersburg. He died 4 July 1802. 66.

GASKET. Rope, cord, or oakum, driven tightly between the spigot and faucet ends of iron pipes at their junction by insertion, to prevent the melted lead, used in making the joint, from running into the pipes. The original term is applied by sailors to each of the small pieces of plaited cord used in furling a sail.

GASPARI (ANTONIO) designed the palazzo Zenobio on the rio del Carmine at Venice, according to CARLEVARIIS, *Le Fabriche*, fol., Venice, 1703, pl. 93: it is called Zanobrio by SELVATICO, *Sulla Arch.*, etc., 8vo., Venice, 1847, p. 465, who also attributes to him the church of Sta. Maria di Consolazione, called della Fava, but as works of the eighteenth century.

GASSE (STEFANO and LUIGI), twin-brothers, born 8 Aug. 1778 at Naples, were sent, at about the age of seven years, to Paris for education. They obtained 1801 the *grand prix* by a design for a *prytaneum*, which under special permission they were allowed to submit in partnership, and consequently went to Rome, whence they transmitted 1803 a restoration of the temple of Mars Ultor. After five years of study there, they settled at Naples, where Luigi appears to have given the designs, while Stefano attended to the practical construction, of their works. Naples owes to them many of its best modern edifices; among the more important are, 1812-20, the royal observatory at Capo di Monte di Mirados; additions 1834 of 1200 ft. in length to the villa Reale or public promenade called Chiaja, with its buildings; the reale edificio di S. Giacomo, 1819-25, or palazzo de' Ministeri, between the strada Toledo and the piazza Castello Nuovo, an immense pile of building erected at the cost of 1,500,000 ducats, containing the bank, exchange, prefecture, palace of ministries and financial administration, office of chancery now council of state, and a great number of other public offices; the dogana or new custom house; the walls around Naples; and the barriers. The observatory is chiefly attributed to Stefano, acting on the instructions of the astronomer Piazzini.

Amongst the private works are the large palazzo Montemiletto; a villa for Lady Drummond; that for the duca di Terranova; the casino Cacace at Sorrento; the casino Dupont; and that called 'di Sofia' in the strada Nuova di Posilipo, for the president Sofia; the streets Santa Lucia and Mergellina; and 1837 the entrance to the new Campo Santo near the strada Nuova di Poggio Reale; but these last Stefano did not complete, as he died at Naples 21 February 1840. He was made a cavaliere by the cross of the order of Francesco Primo; architect to the king of Naples; and 1836 corresponding member of the Royal Inst. of British Architects. Luigi had died 11 November 1833 or 1835, having been elected corresponding member of the French Institute just before his death.

Stefano was also engaged upon a new street leading to the port; a new square at the entrance to Naples from the Poggio Reale in the Egyptian style; and he had projected a magnificent embellishment for the city, in an extension from the royal palace to the Chiaja gardens. He contributed a view of the passaggio covertò nell' Edificio dei Ministeri di Stato (Gasse, inventò e costruì) i, pl. 62; and ii, pl. 17, one of the observatory, to the work by CUCINIELLO and BIANCHI, *Viaggio Pittorico nel Regno delle due Sicilie*, fol., Naples, n. d. Memoir by T. L. Donaldson in the ARCHITECT, ENGINEER, etc., *Journal*, 1843, 4to., London, iv, 102. 14.

GATE. An open frame of iron or wood, serving as a door. It consists of a rectangular frame which, aided by a diagonal bar joining the top of the heelpost with the foot of the

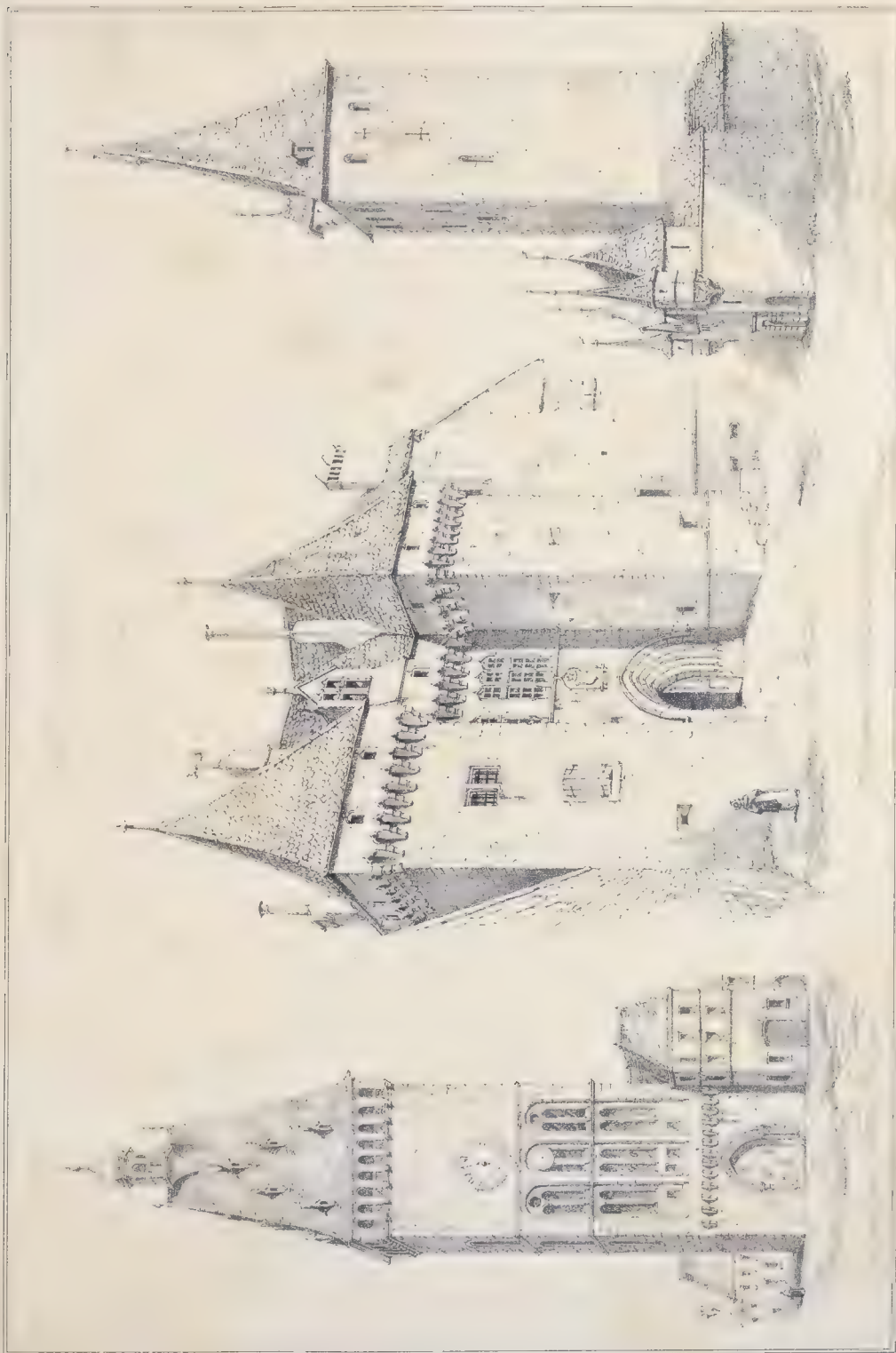
headpost, shows two triangles that form the true elements of a properly constructed gate; all the other parts being subordinate to these, and adopted solely for the practical purposes of the gate as a defence or for ornament. Some remarks in the *BUILDER Journal*, xvi, 566, 614, on the construction of field-gates, advocate the reverse position of the diagonal bar. The best construction for large gates is diagonal bracing both ways, forming four triangles. The framework of iron gates ought to be made with wrought iron, whatever be the quantity of wrought or cast metal as decoration to the panels. The tendency of a heavy gate to pull over the post to which it is hung, must always be counteracted by a head of some material; or at least in the case of gate piers, by long ANCHORS to the hinge stones; and in the case of posts, by braced framing below the sill, with struts to the front and back of each post. A gate for a level crossing on a railway, where it is required to be of great width, is given in BRES, *Railway Practice*, 4to., London, 1847, ser. 3, pl. 37; and a rolling gate for a similar purpose in ANNALES DE LA CONSTRUCTION, fol., Paris, 1857, iii, 21-4. A gate to a factory or to a workshop is sometimes hung to slide in the manner noticed *s.v.* DOOR; an example is shewn in DALY, *Revue Générale*, 1844, v, pl. 6, with a comparison of the old system of hanging the gate. Most publications relating to the Decorative Arts give illustrations of gates and doors more or less ornamented.

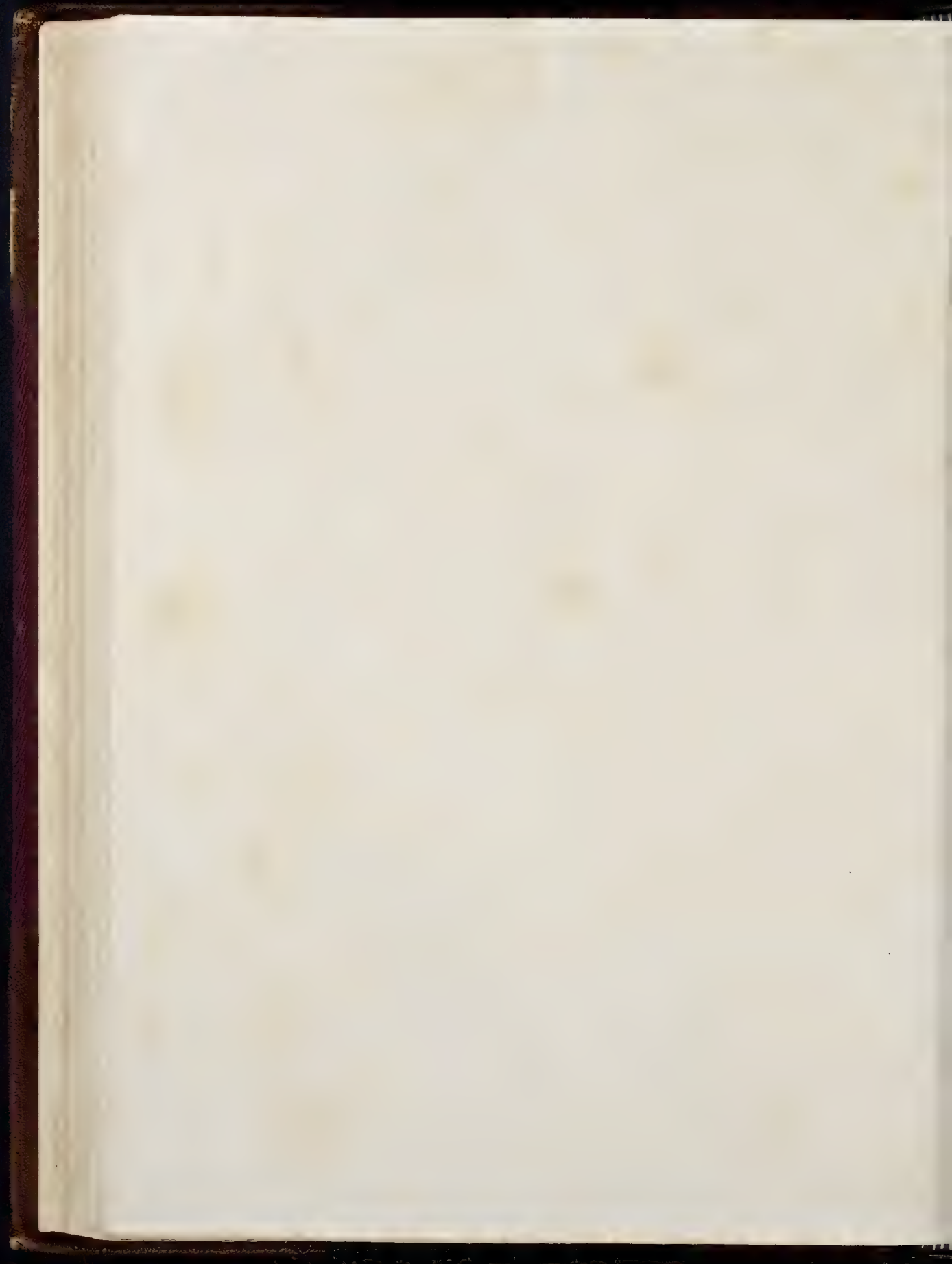
GATEHOUSE. A building attached to the gateway and forming the residence for the gatekeeper. The PROPYLON of Egyptian and Greek art, and the PORTA of Roman times, will be treated *s.v.*, the present article is confined to the gatehouse of the mediæval period.

The building, which defends the passage of a bridge over a moat or over a stream, and to be seen most numerous in Germany; the building, which forms the entrance from a street to the precincts of a castle, and to be seen in great variety in France; the building, which serves a similar purpose in a town, and to be seen advantageously in England; all these may be supposed to have had over the gateway the necessary means for moving a portcullis, and a chamber for a military guard. Less fortified, but still rather warlike in aspect, was the gatehouse, which gave admission to the precincts of ecclesiastical establishments; and in this the upper room, not used by guards, may have served as a guest chamber, unless that apartment was provided adjoining to the gate. The gatehouse of a great mansion seems frequently to have had a portion of this upper room reserved as a chapel. The military type is of course either a tower, with or without turrets, and having plain or machicolated parapets, and a flat or a steep roof, or a curtain wall between two towers under the same conditions. The civic type is more decorated. The monastic exhibits the gabled variety, as well as the rectangular structure flanked by two or more conspicuous turrets: the collegiate type is a richly ornamented tower. The domestic gatehouse resembled the rectangular monastic type with two or more stories till a late period, when the gatehouse detached from the gate became a LODGE. The words 'gatehouse' and 'gateway' are sometimes used as synonymous, but the latter is properly applied to a wide opening in a wall without any attached residence. *Reports and Papers of Associated Societies for 1860*, v, pt. 2, 247-62, gives *Monastic Walls and Gatehouses*, by Rev. E. Trollope, reprinted in *BUILDING NEWS Journal*, vi, 515-6; PARKER, *Dom. Arch.*, 8vo., 1853-9, ii, 190; iii, 186-200; Paper by J. BRITTON on *Ancient Gatehouses*, in *Proceedings of the Archaeological Institute at Norwich*, 1847, p. 127, and given in *BUILDER Journal*, v, 381-2; *Illustrations*, 1858-9, s.v. Entrance Gateway; Gatehouse; and Gateway.

GATEWAY. This term should be restricted to a covered entrance in a wall; PORTE-COCHÈRE; but it is commonly applied to a wide entrance, whether open or covered, closed by a gate. BARRIER.

GATHERING. Where the fireplace in one story is





GATE HOUSE



Gate House, NEVERS



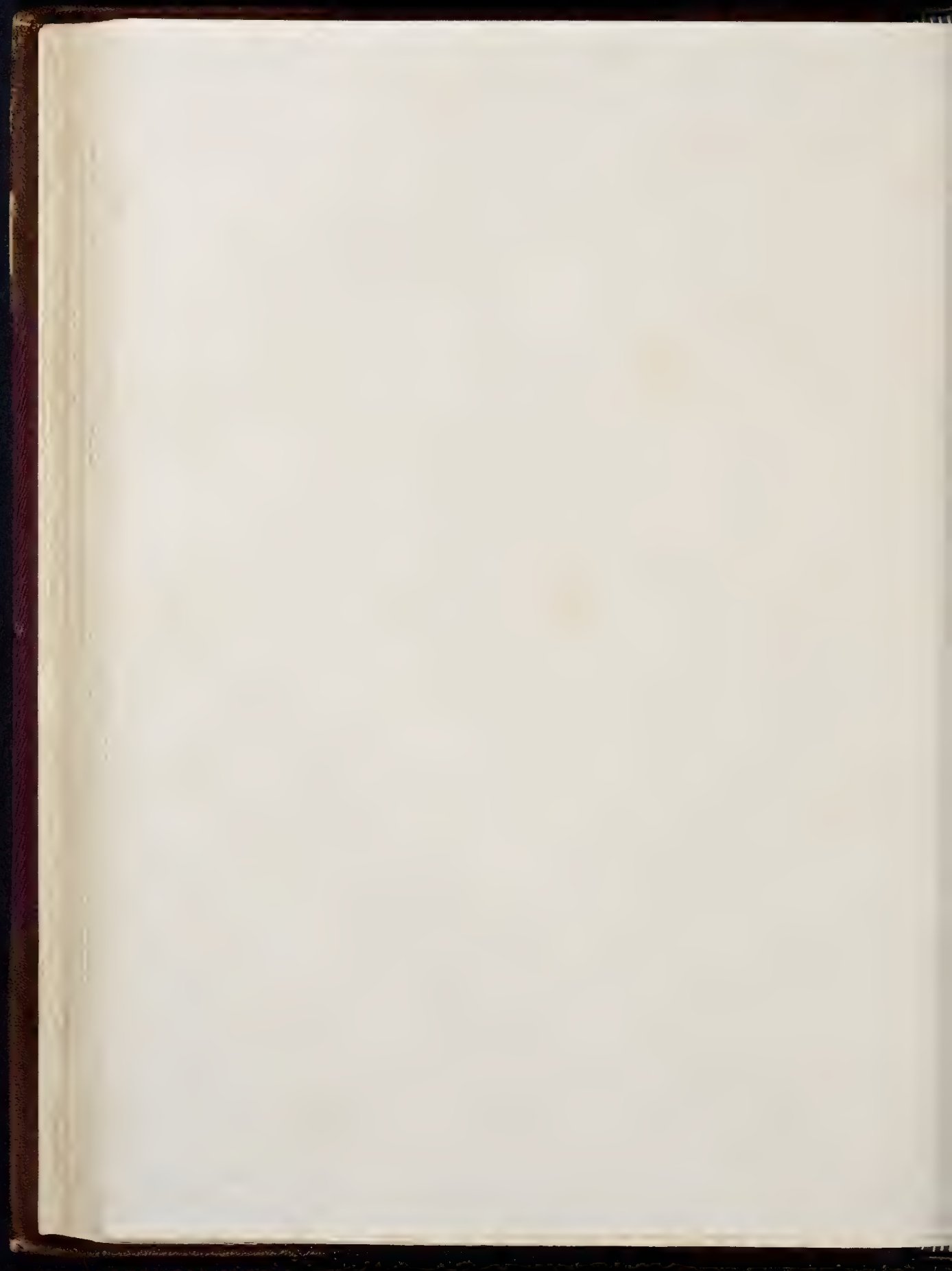
Porte de Croux NEVERS



Old Gate Town Walls, LAON
1, 2 & 3 John T. Christopher M.I.B.A.



Town Gate, SOLEURE
4 C Row Clarke



GATEWAY

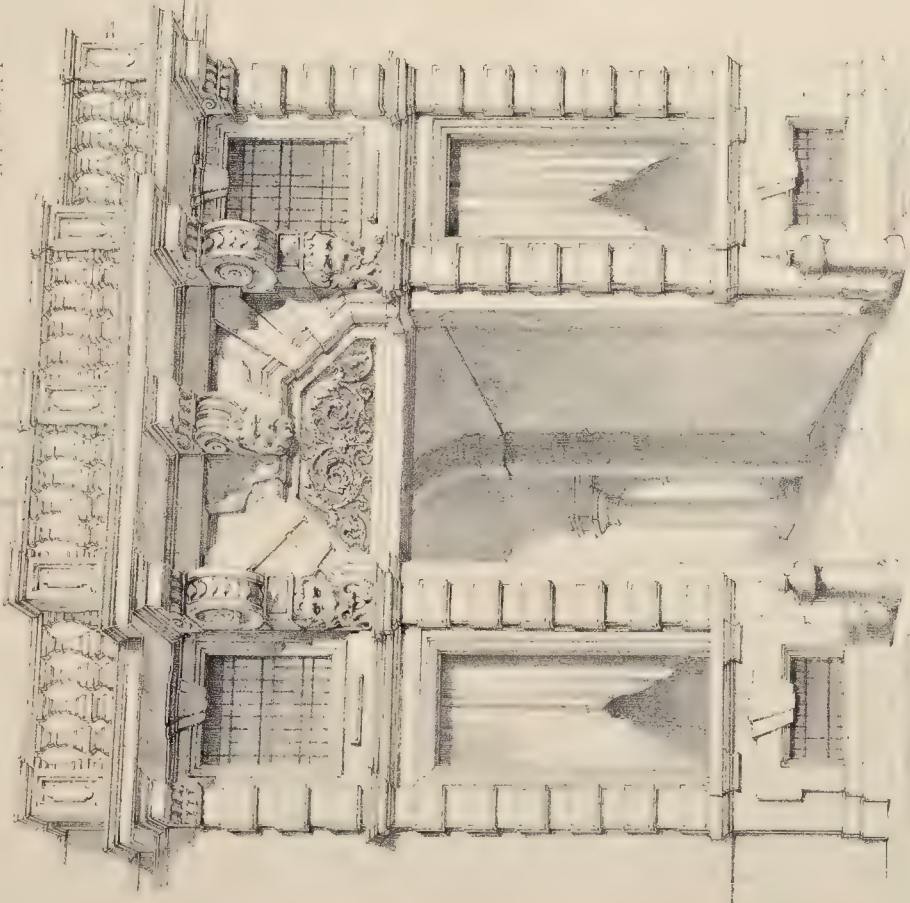


PLATE 1

PLATE 1

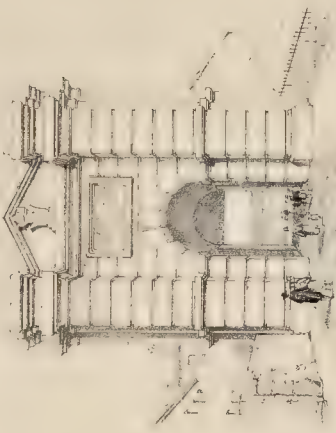


PLATE 1

PLATE 1





directly over another, and the flues go up in the jambs, the brickwork which oversails and forms the soffit of the with of the flue is called the gathering. It should always, if possible, be constructed so as to bend away from the door, otherwise draughts will be liable to drive the smoke against the gathering wing and thence out into the room, instead of assisting its passage up the flue. Hence the term is loosely applied instead of GATHERING OF THE WINGS or GATHERING WINGS, to that part of a chimney funnel which is built inclined over the fireplace, so as to contract the sides to a union with the throat of the flue. This should be effected by as gentle an angle as possible, in order that the smoke may not be interrupted in its ascent. The *BUILDER Journal*, 1849, vii, 526, contains a notice that the gathering is usually started from the top of the arch, or 15 ins. higher than the place therein recommended, viz., not less than 6 ins. below the underside of the chimney bar, corbelling 2½ ins. in every course. The brick gathering of the wings is now often superseded by a cast iron CHIMNEY HOPPER. HOOD.

GATHERLEY MOOR. The stone obtainable at this quarry, situated near Richmond, in Yorkshire, is a sandstone composed of quartz grains of moderate size, and an argillaceous cement, with ferruginous spots and plates of mica. It is of a cream colour, weighs about 135 lb. 13 oz., per cubic foot, and supplies blocks of from 1 to 3 tons weight, with a bed 12 ft. thick. It has been employed at Aste Hall near Richmond; Caterick bridges over the river Swale; Purse bridge over the river Tees; Skelton Castle; Darlington Town Hall; Lockburn Hall; and numerous modern buildings. The keep of Richmond Castle (11th century) is built of stone similar to that at Gatherley Moor, and is generally in good condition; the moldings and carvings in the columns of the windows are in a perfect state. *Report on Building Stones.*

GATTA (DON BARTOLOMEO DELLA) called B. d'Arezzo, and Abate di S. Clemente, because he obtained that dignity in Arezzo, where he designed after 1490 the church of the SS. Nunziata, afterwards of the Madonna delle Lacrime (completed by A. Contucci); the hospital for females; and 1473-97 the loggia from the vescovado to the duomo. VASARI says he died 1461 aged 83, and that he was employed by SIXTUS IV (1471-84); LANZI and TICOZZI both notice this error. He probably died about 1501.

GATTON STONE. One of the subordinate members of the upper green sand series, is worked near Gatton, in Surrey, for the *freestone*, as it is commonly called, of the London market. It is a calcareous sandstone with particles of the silicate of iron and of mica, rather soft, a very light grey, tinged with green, in colour, and easily disintegrated by moisture, but able to resist very high temperatures; on which account it is used for lining the sides and backs of hearths. Blocks are rarely obtained of larger dimensions than from 20 to 25 cubic feet, though some from 35 to 60 ft. cube have been procured, and from 4 to 10 ft. long, but they are hardly ever so much as three feet in thickness. At present Gatton stone is little used; the freestone still employed is principally obtained from the neighbourhood of GODSTONE, but fire bricks and tiles are rapidly displacing the whole of this class of materials. Gatton stone is perhaps one of the lightest stones found in the United Kingdom, as it weighs only 103 lb. to the cubic foot.

The Gatton freestone does not differ in composition or external character from the Godstone variety of the same series, and both of them were formerly much used in the mediæval buildings of the valley of the Thames; as for instance in the Temple church; the Tower of London; S. Saviour's church, Southwark; Westminster Abbey; Hampton Court; the town hall and almshouses at Croydon; as well as in several modern houses at Gatton; and generally in the neighbourhood of Reigate, and in the county of Surrey. G. R. B.

GAU (FRANÇOIS CHRÉTIEN) born at Cologne 15 June 1790, became 1809 a pupil of Debret and Lebas; and studied for

four years at Rome, which city he left April 1818 for Greece, Egypt, and Syria. On his return to Paris he published *Antiquités de la Nubie—entre la première et la seconde cataracte—dessins—en* 1819, fol., Stuttgart and Paris, 1820-27, with a German edition *Neu entdeckte Denkmäler von Nubien*; and received 1825 the cross of the Legion of Honour. He also edited the third part of MAZOIS, *Les Ruines de Pompéï*, fol., 1829, with the fourth part in 1838.

He became city architect at Paris, where he restored the church of S. Julien le Pauvre; designed 1827 the presbytery of S. Séverin, given in NORMAND, *Paris Mod.*, 4to., Liège, 1846, ii, 65-6; and in GOURLIER, BIET, etc., *Choix d'édifices*, fol., Paris, 1837-44, ii, 51; which latter work, ii, 220, gives, 1829, the caserne de gendarmerie at Lyon; and 326, 1843, arranged for the Lutheran service the church in the rue Chauchat at Paris, consisting of a single aile, 46 ft. wide. In that city he also designed the corps du garde de la Bastille; the great prison of La Roquette, at the barrière d'Enfer; and in 1849-50, with T. Ballu, the fourrière de la prefecture de police, given in the *Moniteur des Architectes*, xvii, pl. 199-204, showing the arch of iron over the hall of 60 ft. span. The large bathing establishment at Enghien is also his work. In 1839, he appears to have been considering the design, being a commission from Louis Philippe, for the Gothic church of S. Clotilde, in the place Bellechasse, at Paris, and DALY, *Revue Générale*, ii, 23-6, prints the letters in reply to his inquiries 1841 on iron as a means of 'consolidation' in Gothic monuments. Four designs were made; the modified one was commenced Nov. 1846; after 1852, Gau becoming enfeebled in health and mind, to his great mortification it was entrusted to T. Ballu (and finished 1855), which was the cause of his death at the end of 1853, or in January 1854. Plan and details of the iron roof are given in the ALLG. BAUZEITUNG for 1859, pl. 265-7; ECCLESIOLOGIST *Journal*, 8vo., London, 1853, xi, 37, 312, 392. He was an hon. and corr. member of the Royal Inst. of Brit. Architects. 110.

GAUCHE (FRANÇOIS TRANQUILLE) born 1766, at Choisy le Roi, was a pupil of De Wailly. His principal works are at Paris, 1811 and 1824 the tombs of the families of Lépine and of Marescot, in the cimetière de l'Est; 1810 the abattoir des Invalides; 1811-36 the Entrepôt général des vins et eaux de vie, given in GOURLIER, &c., *Choix d'édifices*, fol., Paris, 1837-44, i, 134-7; and 1815 the maison de détention pour les délits politiques (ancien hôtel de Bazancourt): he executed different works of reparation in the establishment of the Jeunes Aveugles, rue S. Victor; and made many designs for houses and public buildings, besides 1801, a monument to Desaix, given in DETOURNELLE, *Arch. Nouv.*, 4to., Paris, An. xiii, (1805) pl. 54. He published *Divers projets d'édifices proposés en 1841, pour transférer la bibliothèque royale dans les xi ou xii arrond. de Paris*, fol. In 1809 he obtained the second grand prix, and was named expert du cadastre; in 1819 he became member of the jury of the school of architecture; honorary member of the conseil des bâtimens civils; and was professor at the Polytechnic school. He died 23 May 1846, aged 80. 110.

GAUDENTIUS is presumed to have designed the Flavian amphitheatre at Rome (which, commenced A.D. 72 was first used in 80; COLOSSEUM,) and to have been a Christian martyr, from an inscription (now in the church of Sta. Martina sul Foro Romano), given by VISCONTI, *Sposizione*, 8vo., Rome, 1824, p. 24, and inconclusive if genuine, but seems spurious.

GAUGE or GAGE. An instrument used by joiners for drawing, marking, or striking, on the side of a piece of stuff, one or more lines giving a width or widths parallel to one of the arrises of that side. There are five sorts of this tool; 1, the common gauge; 2, the flooring gauge (either of these being applied in marking a line parallel to an arris); 3, the internal gauge; 4, the mortise and tenon gauge; and 5, the cutting gauge. The common gauge generally has a head, which is a piece of wood with a hole in it, through which a sliding bar called the stem, runs at right angles, being furnished

with a sharp point or tooth, projecting a little from the surface at one end; the head is applied against the arris, and the workman, keeping down the pin or point, pushes the instrument alternately from and towards him, until a scratch sufficiently visible is made. When it is required to mark a mortice, the gauge has two teeth in it, the secondary point being moveable in a mortice between the fixed pin and the head, so that the distances of the teeth from each other and from the head, may be set to the proposed thickness and place of the tenon. The cutting gauge has a broad knife-like iron, instead of a mere point, and is used for cutting slips of thin stuff into parallel widths.

1. 4.

GAUGE. The name given to the width of that portion of each course of tiles or slates, which is visible when the materials are fixed in their places in roofing. *Plain tiles* are laid to gauges varying from 3 to 4 ins.; a square of tiles, of the size of $10\frac{1}{2}$ ins. by $6\frac{1}{2}$ ins. (statute 17 Edward IV), required 760 tiles at 3 ins., 665 at $3\frac{1}{2}$ ins., and 570 at 4 ins., gauge: but the numbers are reckoned 800, 700, and 600: as the tiles are taken to be larger or smaller, the numbers vary, in the text-books. *Pantiles*, formerly made $14\frac{1}{2}$ ins. by $10\frac{1}{2}$ ins., and fastened with 4d. nails, were then laid at a $10\frac{1}{2}$ in. gauge; 172 or 170 tiles being allowed to a square as the tile showed a breadth of 8 ins. when laid; and a square of such tiles made $13\frac{1}{2}$ ins. by $9\frac{1}{2}$ ins. (statute 12 George I., cap. 25), having $1\frac{1}{2}$ in. side laps, required 180 tiles at 10 in. gauge, or 150 at 12 ins. gauge. A pantile at present is made $14\frac{1}{2}$ ins. by $9\frac{1}{2}$, but it shows a breadth of $8\frac{1}{2}$ ins. when laid, and the numbers are reckoned 180, 164, and 150, for 10, 11, and 12 in. gauges. Although the bare or margin of pantiles and slates is meant by the word gauge, plain tiles with a $3\frac{1}{2}$ ins. bare, are sometimes improperly described as laid at a $6\frac{1}{2}$ ins. gauge, but in this case the distance from the top edge of one lath to that of the next but one (i. e. omitting the counter lath) is intended.

The term gauge, improperly applied, like **BOND**, to the distance from the nail of one slate to the lower end of the next slate above it, means half the length of the slate, less by half of the bond that may be chosen by the architect; thus, if a duchess slate, being 24 ins. long, had 3 ins. bond, the gauge would be $10\frac{1}{2}$ ins. The distance from the top edge of a lath to that of the next lath, is therefore also called a gauge by slaters.

Gauge also means a fixed rigid measure, as wire gauge, plate iron gauge, &c.

GAUGED AND RUBBED BRICKWORK. This term is generally used inverted, viz., rubbed and gauged brickwork. It formerly meant work where "the workman must gauge and rub down the red-stock bricks, so that every five courses of them shall come level with every four courses of place-bricks worked up with them withinside;" *LANGLEY, London Prices*, 8vo, London, 1750, p. 130, and such work was then set in putty; but before 1816 the use of mortar in such work was sanctioned for gauged work, and before 1830 fine-stuff took the place of putty. The term is now chiefly applied to arches and niches.

GAUGED STUFF. The mixture produced by the plasterer when adding to FINE-STUFF a portion of plaster of Paris, to accelerate its setting. The fine-stuff should be four-fifths of the mixture, but this proportion is often lessened when time is an object. Gauged stuff is chiefly used for fine brickwork, and for moldings run with a template of wood or zinc. The introduction of this mixture seems to be comparatively recent; lath plastered floated and set with gauged putty, appears in the *price books* between 1830 and 1840. Lime and hair for repairs of ceilings, mixed with plaster of Paris in like manner, is also called gauged stuff. Mortar mixed with Roman cement to accelerate the drying of the brickwork, is also called gauged mortar.

GAULT. One of the subcretaceous formations interposed between the chalk and the wealden deposits, or between the chalk and the upper oolite. This term has been adopted by geologists of all countries; but the gault is often wanting in the

subcretaceous series of the continent, and indeed in some instances (as at Highgate and Harwich), in England. Occasionally also the whole of the group is wanting, and the chalk marl reposes upon the early secondary, or even upon the primary rocks. The gault formation serves as the retaining stratum which produces upon the water falling upon, and charging the basin of the permeable lower green sand, the pressure requisite to enable it to rise in the form of an Artesian spring. This actually occurs at Tours, Rouen, Paris, and at Brighton, in all of which cases the water was found after the impermeable stratum of gault, underlying the upper green sand and the chalk marl, had been traversed throughout its thickness. The gault is generally about 100 feet thick, but instances of its attaining as much as 270 feet in thickness are recorded. A peculiarity connected with the gault clay is its tendency to slip, when the natural conditions of the strata have been disturbed. It is desirable, therefore, that any excavations or embankments executed in this clay should have slopes dressed to an inclination of 3 to 1.

Gault clay is used for brick and tile-making on a very large scale; occasionally it passes into fuller's earth, with nodules of the phosphate of lime associated, when there is an abnormal mixture of green sand. The composition of gault clay varies; for though it is of a tolerably uniform dark blue colour, it sometimes contains large quantities (comparatively) of the hydrous oxide of iron; and in others it contains much of the bicarbonate of lime, in combination. The clays which contain the iron, burn in the kiln into a deep red brick and tile of rather inferior quality; whilst the clays containing the bicarbonate of lime are used to a considerable extent for the manufacture of the pierced hard white bricks, known as Beart's patent bricks, and which are chiefly made at Arlesey near Hitchin. The clays producing the white bricks require, however, to be burnt with great care; for if the calcination of the bicarbonate of lime should take place under such conditions as to leave the lime in the caustic state, it will slack on exposure to the weather, or when moisture is applied to it.

G. R. B.

GAUNTREE, GANTREE, or GAVNTREE. A provincial name for a travelling crane; it was formerly also applied to the stand for a cask in a cellar.

GAUTHIER (MARTIN PIERRE), born 9 January 1790 at Troyes, was a pupil of Percier at Paris. Besides the restoration of the chapel of the castle of Vincennes, his principal works are the quartier neuf des aliénés at Bicêtre; the monument to Fénélon at Cambrai; 1825 the école publique, rue de Fleurus, given in NORMAND, *Paris Moderne*, 4to., Liège, 1843-6, ii, 114-5, and in GOURLIER, etc., *Choix d'édifices*, fol., Paris, 1837-44, ii, 78; 1824 the pulpit of the church of S. Gervais; the bureau des nourrices, rue S. Denis; 1829 the church of S. Jean at Bonneval (Aube), GOURLIER, ii, 121; 1834 a house in the rue d'Alger, No. 3, NORMAND, i, 101-3; 1836, with Delannoy, the hospice de la Reconnaissance at Garches or Petit l'Etang, near S. Cloud, NORMAND, ii, 90-1; 1837-41 the halle aux blés, and 1840 the hospice de S. Nicolas both at Troyes (Aube), GOURLIER, ii, 269, 282-3; the dépôt de glaces, rue S. Denis; the hospice des Orphelins; and the hospice de la Riboisière at Paris; the Du Guesclin monument at Mende, etc. While the hospital at Troyes was being executed from his designs, bad health did not permit Gauthier's attention to the work; the edifice becoming insecure, his responsibility was assessed at 200,000 fr.; he was imprisoned for nonpayment of that sum, and died in confinement 23 May 1855.

He obtained medals, for an hôtel de ville in 1808; the first *grand prix* for a theatre and café in 1810; and for a basilica in 1819; in 1815 designed at Rome a restoration of the temples of Peace and of Mars Ultor; was appointed architecte des hospices; was elected a member of the French Institute in 1841; and an honorary and corresponding member of the Royal Inst. of British Architects. He published *Les plus beaux édifices de la ville de Gènes et de ses environs*, fol., Paris, 1818-32. 110.

GAUTIER, who built 1170-85 the cathedral at Palermo, is considered to have been a Frenchman by DUSSIEUX, *Les Artistes Franç.*, 8vo., Paris, 1851, 258.

GAUZE. For various purposes, fine wires of metal are occasionally employed, in the form of a woven cloth of different degrees of fineness or openness of texture, which is known technically by the name of wire gauze. It is used for window-blinds, screens round lamps, carrying frames of paper making machines, and sieves; the wires may be of platinum, gold, or silver for chemical purposes of great importance, and of copper, brass, iron, and zinc for commoner uses. It is stated that the first mills for drawing iron wire were erected in England by some German mineralogists in 1568; the first patent for drawing zinc wire is dated in the year 1806. Very coarse galvanized iron wire gauze, the spaces being about quarter of an inch square, was about 1849 introduced in plasterer's work in place of ordinary lathing; it is specially useful near chimneys and stoves.

G. R. B.

GAVEL, GAVIL, or CAVIL. Corruptions of GABLE which are still in use in Scotland. 4.

GAVELOCKE. A crowbar or lever of iron used principally for raising stone; the word is still current in the North; SURTEES SOCIETY, *Fabric Rolls of York*, 8vo., Durham, 1859, 343; and, in the North also, it means an iron bar employed to drive stakes into the ground. 4.

GAVILAN TOME (SIMON), see TOMÉ (S. G.)

GAY (JOSEPH JEAN PASCAL, not Paul, as sometimes printed), born 14 April 1775 at Lyon, studied under the elder Cochet and under Leroy at Paris; became professor in the école des Beaux Arts at Lyon. He competed for the Condition des Soies there, and though unsuccessful, he was soon after its erection employed to repair the damages caused by the failure of the centre vaulting. In that city he designed the halle au blé; restored the choir of S. Just; 1806-26, with Dardel, contrived the additions of the musée with the palais des arts et du commerce, at the hôtel de ville in the buildings of the former monastery of S. Pierre (GOURLIER, etc., *Choix*, fol., Paris, 1837-44, iii, 321-4); and 1828-30, with Hotelard, built the caserne de la gendarmerie (GOURLIER, ii, 220-1). He was succeeded 1813 by Flacheron as city architect; spent many years chiefly in Italy, and, returning to Lyon, designed the funeral chapel of the Mont-Mélas family near Ville Franche, and several villas. He died 16 May 1832, according to F. RICHARD, *Notice*, 8vo., Lyon, 1832, cited by BREGHOT DU LUT, *Biog. Lyon.*, 8vo., Paris, 1836, p. 124.

GAYETTE (PETER VON), a Frenchman, was colonel of engineers in the service of the king of Prussia. He designed 1720-34 many houses; the rath house; the long stable for the royal saddle horses; and probably the Heilige-Geistkirche, (except the tower, which was by Grael) at Potsdam, where he died 1747, according to NICOLAI, *Bemerkung*, 8vo., Berlin, 1786, iii, who observes that his buildings, erected by order of the king, were chiefly of timber plastered.

GAYFERE (THOMAS) was appointed jointly with his father (who had been employed as mason in building Westminster bridge) to the office of master mason at Westminster abbey, 7 Dec. 1802. In 1807-8 measures being taken to commence the restoration of Henry VII's chapel, he, by direction of the committee, proceeded to S. Alban's abbey church and Woburn abbey to inquire into the nature of the Totternhoe stone, and to Bath to inspect the quarries; the result being the use of Coombe Down Bath stone for the work. He received 11 May 1809 the order of the dean to commence the repairs (the early portions being under the direction of James Wyatt, who died 1813), which were concluded at Christmas 1822, at a total cost of upwards of £42,000. All the molds were carefully laid down full size on the drawing room floor of Gayfere's house in Abingdon-street; and during the whole time he was so anxious to insure accuracy, that he would frequently devote entire days in searching the building for authority for the

restoration of a molding or an ornament; and he had to collect and also to instruct the workmen and carvers in the then little known style of architecture. COTTINGHAM, *Chapel of Henry VII*, fol., London, 1822, gives the detail of the operations connected with this important undertaking.

During 1819-22 he restored, also with Bath stone, the north front of Westminster hall, except the regal statues; at this period an additional tier of windows was inserted in the slope of the roof on each side, and the lantern was put up in cast iron, copper, and oak: the works at the hall were under the direction of J. W. Hiort of the Board of Works. Gayfere retired early in 1823; and died at Burton-on-Trent, Staffordshire, 20 Oct. 1828; GENTLEMAN'S MAGAZINE, xcvi, pt. i, 275.

GAYNISBURGH or GAINSBOROUGH (RICHARD DE). An incised slab in the cloisters of Lincoln cathedral, exhibits a full length effigy with doublet and hooded cloak, under a rich three-gabled canopy, with a mason's square above the left shoulder. The following inscription: "Hic jacet Ricardus de Gaynisburgh, olyn cementarius hujus ecclesie qui obijt duodecim Kalendarum Junii An' D'ni mccc", the concluding figures being obliterated, is given in GOUGH, *Sep. Mons.*, fol., 1786-96, ii, 95; the greater part of it is now shattered.

GAZ or GUZ. A common measure of length in Hindostan: it was formerly 32 ins., and even more in some districts, but the East India Company fixed it at 33 ins. BIGAH.

GAZEBO. It is difficult to assign an origin for this word, which was in use during the last century for a garden house built at the corner of the walling, and having a room on the first floor with windows on every side. It recalls the observation of LABORDE, *Versailles*, 8vo., Paris, 1839, p. 505, who says 'il y avait dans presque tous les jardins, d'obligation, une tour de Marlborough'; but the gazebo rather implies a room from which to overlook the traffic on the road.

GAZELLE'S HORN. The common name of the plant cyclamen, a most common flower of the Holy Land, and evidently the type of the dog-tooth molding, according to WIGLEY, *Transactions of the Royal Institute of British Architects*, 1855-6, p. 105.

GAZOPHYLACIUM. This word is derived from the Persian *gaza*, a sumptuous palace containing a treasury, through the Gr. γάζα, a treasure, and φυλάσσω, I guard, and in its Greek form was used not only for the treasury of a church, but for the habitations of the ministers and vergers, according to BINGHAM, *Origines*, 8vo., London, 1840, ii, 476; and was applied to catacombs in later times, as stated by ROMÉLOT, *Descr., etc., de l'église*, 8vo., Bourges, 1824, p. 273, evidently in the sense of a place where precious things are deposited.

GAZZO (BARTOLOMEO) furnished 1463 the plan for the church of S. Sigismondo, outside Cremona; but 1440-66 are the dates usually assigned to this building. 68.

GEAY (JEAN LE), see LEGEAY.

GEBER, see GEYER.

GEBHARD (JOHANN AUGUST), born 1735 at Dresden, was a pupil of Knöbel and Exner; was much employed in his native city, where he built the large Bayerische brauhaus; finished the Japanese palace; and died 1809. 68.

GEDNEY (JOHN), in 1391-2, 15 Richard II, succeeded G. CHAUCER as Clerk of the Works (who appointed a deputy 22 January,) at the Collegiate Chapel of S. George, Windsor Castle; on 16 Sept. of that year Gedney appointed a deputy. TIGHE and DAVIS, *Windsor, etc.*, 8vo., London, 1858.

GEFLE, in Sweden, see DEAL and BALTIC TIMBER.

GEISON. (Gr. γείσων.) This Greek term meant each block of stone employed in the formation of the corona and its subordinate moldings in an entablature; WILKINS, *Prolusiones*, 4to., London, 1837. It originally meant a coping projecting before the face of its wall. INWOOD, *Erechtheion*, fol., London, 1827, 94, does not appear to be aware that the term was applied to other blocks than those of a raking corona.

GEMENT. A word said to be used in a MS. of the time of Henry VII, in the Herald's College, describing the hall at Richmond palace; the *ANTIQUARIAN REPERTORY*, 4to., London, 1808, ii, 315*, as copied in HUNT, *Tudor Arch.*, 4to., London, 1836, 94, quotes the "rof is of tymber—after the moost new invencōn and crafte of the prospctif of Gement"; but upon inspecting the MS., the words are found very illegible; 'gement' is written g'mentl, and the word following is 'crafte'. The passage may be read, therefore, with greater probability "and pure use of geometrical crafte". A. A.

GEMELLE. A town near Sitifis, in the province of Numidia in Roman Africa, now called Djemila, Jedmila, Jemila, or Jimmeelah. A plan of the locality, with details of the forum, two temples, a theatre, and a triumphal arch, are given by DELAMARE, *Expéd. Scient. de l'Algérie*, fol., Paris, 1844 (*Archæologie*), pl. 99-108.

GEMELLE, see **GEMMEL**.

GEMINATED COLUMN. This term has been used by French architects to distinguish columns in pairs with proper intervals, from columns COUPLED having their projecting members more or less in contact; as well as from GROUPED columns, which are ENGAGED COLUMNS. 25.

GEMM, Elgem, El Jemme or Legem, in Tunis, see **THYSDRUS**.

GEMMEL, gemoye, gymowe, and jymewe. Old modes, like chymol and gimmer, of the Anglo-Saxon *gemow* and the Fr. *gemelles* (clamps), and *gêmeaux* (twins), derived from the Lat. *gemellus*, double, or equal. Thus 'gemelle' appears in early documents as the name of a hinge; and 'gemowe lines' mean parallel lines in *RECORDE, Pathway to Knowledge*, 4to., London, 1551. **GARNET**.

GEMUND and **GEMUNDEN**. A common mode of writing **GMUEND**, in Germany.

GENABUM. The ancient name of ORLEANS in France.

GENDRE (JACQUES), also called Jacques de Pigny, designed or planned 1443-53, the house for Jacques Cœur at BOURGES.

GENERALIFE. The Spanish name for a country residence, such as that on the hill opposite to the Alhambra, shown in MURPHY, *Arabian Antiquities*, fol., London, 1815, pl. 89-94, who gives "house of love or of pleasure", as the interpretation of the term, which is really *gene el arife*, garden of the *arife*, maestro, or architect; i.e., in that case, of Yucef Nazar. 66.

GENEVA. (It. *Ginevra*; Sp. *Ginebra*; Fr. *Genève*; Ger. *Genf*). The capital of the canton of the same name in Switzerland. It is built on two hills divided by the river Rhône, which forms an island within the town, also built upon, and is joined to the two banks by bridges; one of these, erected about 1825, is described by DUFOUR, *Pont suspendu en fil de fer*, 4to. A statue of Rousseau is in the promenade on a second island. Woods, *Letters*, 4to., London, 1828, i, 97-181, shows that the cathedral, dedicated to S. Peter, may have been used 1025, that it was being completed 1206-19 and 1300, burnt 1334 and 1349, but repaired about 1380, that the chapel of the Maccabees was founded 1406, that a fire destroyed the west front and left the church in ruins 1430, that the repairs extended over a hundred years, and that the portico of a Corinthian order with the west front was constructed 1749. He considers the choir to be Romanesque and the remainder early Gothic, nowhere showing works of later date in any considerable erection. It has a tower at the end of each transept, and some old glass in the chapels projecting from the apsidal end of the choir; the arches, whether round or pointed, have keystones. The same author states that it is 202 ft. long inside, with a nave of four bays 187 ft. long; a choir of one bay 39 ft. long, and the transepts of two bays each 111 ft. long; the width being 64 ft. 4 ins., with a nave 23 ft. 3 ins. wide, the aisles 10 ft. wide, and the transepts 26 ft. wide; the Pointed vaulting, domical in each compartment, is 63 ft. high in the nave, the springing being 45 ft. 6 ins. high; the height of the vaulting in the

aisles is 35 ft. The chief other public buildings are five churches; a Roman Catholic church commenced in a Pointed style about 1848, which was being vaulted 1858; the English church built 1853, also in a Pointed style; a synagogue in a "Moresque" style; the new palais or government offices; the town hall, lately restored, built of the *grès* or *mollasse*, a greenish sandstone from the neighbouring hill of Coligny; the prison, on the site of the episcopal palace; the arsenal; the college, which is a quadrangular building containing the public library; the post-office in a style called Byzantine; the Rath museum; the *boucheries*; the house of the Sisters of Charity; a theatre built 1782; and two hospitals. BLAVIGNAC, *Histoire de l'architecture sacrée du IV au X siècles dans les anciens évêchés de Genève*, etc., 8vo., Lausanne, 1854. The quartier des Bergues is a suburb on the opposite bank of the river, containing some large hotels and private buildings. The *grès-vert* of the subcretaceous series employed for window dressings, etc., in the town, is procured from several quarries on each side of the lake. The buildings in the upper part of the town well deserve attention, being fine specimens of the Italian style. 28, 50.

GENÈVE (SIMON DE) is said to have designed the tour des halles or du beffroi, at Bruges in 1291; but WEALE, *Handbook to Belgium*, etc., 1861, 136, calls him "Brother Simon of Genoa"; the foundations were laid in brick and stone at a depth of 30 ft.

GENGA (GIROLAMO) born at Urbino about 1476, was educated as a painter, but became architect to the duke of Urbino, for whom he repaired the ducal palace, built another on the Monte Imperiale, near Pesaro; designed the monastery of the Zoccolanti on Monte Baroccio, with the church of Sta. Maria delle Grazie and the episcopal palace at Sinigaglia; and restored the archiepiscopal palace at Mantua, where he built the façade of the cathedral. He died 11 July 1551 at La Valle, and was buried in the chapel of S. Martino in the cathedral at Urbino. 73.

GENGA (ANTONIO), said to have built the church Mondavio, is probably a mistake for the next name.

GENGA (BARTOLOMEO) born 1518, at Cesena, was son of Girolamo, under whose instruction he carried out the church of S. Giovanni Battista at Pesaro. He was a pupil of Vasari and Ammanato; succeeded his father as ducal architect at Urbino and Pesaro, built the ducal palace in the latter town; the church at Monte l'Abate; and the church of S. Peter at Mondavio. He was refused permission to accept employment in Bohemia and at Genoa, but was allowed to go to Malta, where he died in June 1558, from pleurisy. 73.

GENIPA AMERICANA, called *lana*, is a very lofty tree growing on the borders of the river Berbice in British Guiana; the trunk frequently squares from 14 to 18 ins. The wood is close grained, fine, moderately hard, rather heavy, and not liable to split. 71.

GENIUS. The union of fine imagination with sound judgment.

GENLESE. In the description in the fifteenth century by WILLIAM OF WORCESTER (p. 268) of the moldings of the west door of Redcliffe church, Bristol, he states that "the west dore ys fretted in the hede wyth grete genlese and small". A large cusp might be described as a "knee piece," from its form, and genlese is probably a corruption of "GENOUILS"; WILLIS, *Sketch Book of W. de Honecort*, 4to., Lond., 1859, 152.

GENOA or **GENUA**, see **GENOVA**.

GENOA (SIMON DE), see **GENÈVE** (S. DE.)

GENOUIL. This term is supposed to be the mediæval word for CUSP. **GENLESE**.

GENOVA or **GENUA** (Fr. *Gènes*; Engl. *Genoa*). The capital of the division of the same name in the kingdom of Italy. Almost the only remains of ancient art have been worked into the churches, as at those of Sta. Maria di Castello, SS. Cosma e Damiano, and S. Donato. The walls and outworks, constituting one of the largest town-fortifications that

exist in Europe, are the result of several extensions; two gates of the line constructed 1155, are the porta Vacca and the porta di S. Andrea, which, with the cathedral, are said to be the earliest specimens of the pointed arch that exist in Italy. The old streets, rarely more than ten feet wide, are connected by lanes, forming a labyrinth, hemmed in between the harbour and the slope of the mountains. Magnificent improvements were made by forming the strade Nuova 1551, Balbi 1606-18, and Nuovissima 1779, to open communications from one end of the city to the other; the sides of these streets are formed by palaces, generally grandiose and imposing, united with details not always in the purest taste, but shewing much invention and picturesque feeling; the cortili of those on the northern side particularly, though of plain design and simple plan, exhibit some exceedingly scenic and beautiful vistas by the arrangement of flights of steps, arcades, and terraces opening into gardens in the rear at the foot of the mountain; these deserve especial consideration from the professional traveller, on account of the beautiful effects produced by very simple and obvious combinations; the apartments do not always correspond in magnificence with the exterior; the strade Carlo Alberto and Carlo Felice also deserve notice. The *Illustration*, s. v. Genoa, pl. lxxx, will convey some idea of the strada Nuova; the building on the left hand of the sketch is the palazzo Doria Tursi, now the Jesuit college, by R. Lurago of Como; the street is about 25 ft. wide, and paved with flags only. A large number of houses have been built in comparatively wide streets during the present century, especially since 1825 and 1849. Before noticing separately any of the leading buildings, it may be stated that the use of the pointed arch ceased in Genoa about 1450; that the system of casing buildings with brown and grey, called black and white, marble in alternate courses, was allowed only in buildings erected at the expense of the public, and of the Doria, Fieschi, Grimaldi, and Spinola families; and that no particular instances will be noted of the FICTITIOUS ARCHITECTURE which renders remarkable the fronts of many of the buildings in Genoa.

The order for rebuilding the cathedral, dedicated to S. Lorenzo, was issued 1101, and the edifice (perhaps only the choir) was consecrated 1118; the structure (perhaps the nave) was being continued in 1174, was burnt 1296, and repaired 1307-27, with the addition of new vaulting 1312; on one of the inside piers is the date 1380, and on the south porch 1383; the choir and side chapels were modernized by G. Alessi, who added the cupola 1567; the presbiterio and coro were decorated 1624. The nave is formed by columns of a Corinthian order of varying height, in courses of Polcevera and white marble, with differing capitals carrying pointed arches supporting an entablature, over which is a range of Early Italian Gothic shafts carrying round-headed arches. The first bay of the nave and the façade may date 1300, the latter has detached shafts at the angles; but the date 1148 is frequently ascribed to the doorways illustrated in GALLY KNIGHT, *Ecclesiastical Architecture of Italy*, fol., London, 1842-4, ii, 32. The date 1313 is sometimes given to the chapel of S. Giovanni Battista, which belongs to the period 1451-96 (the screen has the latter date), and was modernized by G. G. della Porta 1532. Probably the modern portion of the exterior and campanile belong to 1522-32.

The dates of the seventy churches and eleven oratories which remain unconverted to lay uses are not easily obtained, but the majority seem to have been erected at an early period. Excepting those hereafter noted for peculiarities, it may be sufficient to mention (with allowances for the modifications in later times) those of Sta. Maria del Carmine, 1260-62; oratorio di Sta. Croce, 1390; S. Silvestro, restored 1394-1449; S. Marcellino, restored 1484; Sa. Annunziata di Portoria, 1488; S. Sebastiano, 1504; Sta. Maria in Passione, enlarged 1467-1553; S. Salvatore, 1553; Sta. Maria Maddalena, rebuilt about 1576; Sta. Anna, 1584; Sa. Concezione, 1586-1840; S.

Nicolo, 1597; Sa. Annunziata delle Turchine, 1626; S. Benedetto, restored 1613; Sta. Fede, restored 1614; Sta. Margherita, 1623; S. Giorgio, 1629-39; S. Carlo, 1635, façade 1719; oratorio della Morte, 1637, by G. B. Garré; oratorio della Morte ed Orazione, 1640; Sta. Maria del Rifugio, 1641; Sta. Maria dei Servi, the choir rebuilt 1643; Sta. Maria Doregina, about 1650; S. Vincenzo de' Paoli, 1657; Sta. Croce, by C. Mutone, 1667; S. Girolamo e S. Francisco Saverio, 1668; Scuole Pie, 1712; oratorio dei Preti, 1722; S. Torpete, by A. Ricca, 1731; S. Giovanni Battista, 1752; oratorio di S. Antonio Abate, restored by C. Barabino, 1815-20; and S. Sisto, rebuilt on a circular plan with equal arms by P. Pellegrini, 1825, consecrated 1828, and altered by G. B. Resasco.

The churches which are considered most important, though not in all cases for their architecture, are S. Ambrogio dei Gesuiti, a three-ailed church, in plan a Greek cross, 178 ft. long and 121 ft. wide, with an unfinished façade by the Padre Valeriani, who probably built the church; Sa. Annunziata del Guastato, 243 ft. long and 73 ft. wide, built about 1509-47, restored in the following century by D. Scorticone and G. Porta, with a façade commenced by Barabino; S. Donato, exhibiting late Roman work, the round arches of the nave spring from columns of granite and of Cipollino marble, the campanile is hexagonal; S. Filippo Neri, 1674-1712, and its oratory by G. B. Montaldo 1749; S. Giovanni di Pré, still showing some round arches which have been ascribed to the tenth or thirteenth centuries; S. Luca, rebuilt by C. Mutone 1628; Sta. Maria Assunta in Carignano (given in GAUTHIER), in plan a Greek cross with a dome, by Alessi, 1552-1600, and with a façade of the eighteenth century; Sta. Maria di Castello, consecrated 1237, some parts as old as 1350, decorated 1441, and later still shows in the nave round arches resting on the Corinthian and Composite capitals of granite columns, the presbiterio and the coro 1449, the sacristy 1452; Sta. Maria di Consolazione, by P. F. Cantoni, succeeded by G. B. Grigo, 1637; Sta. Maria Invalata, of coursed black and white marble, soon after 1336; Sta. Maria della Pace, 1568-73; Sta. Maria del Rimedio, on a circular plan, soon after 1650, façade by C. Barabino, 1794; Sta. Maria della Vigne, restored 1586 and 1680, recently cased with marble by Ippolito Cremona; S. Matteo, rebuilt 1278, with a tribune moved bodily a distance of 25 braccia, is a good specimen of the Early Pointed style in Genoa, and the cloisters are dated 1308-10 on the capitals, it was renewed inside by G. A. Montorsoli 1525; S. Pancrazio, rebuilt 1684; S. Pietro di Banchi, rebuilt 1584 by T. Carloni, succeeded by D. Casella; S. Siro, with arches on coupled monolithic marble columns 1576 by Tommaso Carloni (given in GAUTHIER, who calls him Taddeo), its chapel of the Annunciation by D. Casella but nothing of his date is visible since the decorations by R. Pennone, the two columns to the entrance of each chapel are of Seravezza marble, the façade 1820 is by C. Barabino; S. Teodoro; and lastly S. Tommaso, with an interesting crypt having columns formed by capitals of a late period on shafts that have classic capitals reversed as bases.

The charitable establishments are on a magnificent scale: among them are the Albergo dei Poveri, for 2,200 inmates, a building 560 ft. square divided into four courts each 170 ft. square, by the church in plan a Greek cross with the altar in the centre, it was commenced by A. Corradi, G. Gandolfo, A. Torriglia, and G. B. Grigo, 1655-60 (given in GAUTHIER), but their whole design has not been carried out; the collegio degli Orfani, 1684; the conservatorio Fiesche, 1749; and the conservatorio Interiano, 1623; the deaf and dumb asylum in the former nunnery of the Bridgetines, the façade renewed by G. B. Resasco about 1843; the Manicomio or lunatic asylum for 700 patients, in plan a centre with six rays, 1830-40; the ospedale di Pammatone, for a thousand sick persons and three thousand orphans, enlarged and modernized by Andrea Orsolino 1758, is given by GAUTHIER as the ospedale degli Incurabili, which is another building with a façade by

G. Gaggini, 1780; the ospedale di marina, in the former nunnery of the Clarisse, built 1630; and the ospedale militare.

Among the public edifices are the palazzo ducale, called reale 1637 and later, so much renewed that the only visible mark of its erection 1292 by M. Boccanegra is the tower, sometimes dated 1289, to which additions were made in brickwork 1539; it was enlarged 1388, when the *salone* was constructed; altered 1432, and restored or almost rebuilt 1591 by A. Vannone, to whom GAUTHIER ascribes the present edifice as enlarged 1642, including the *salone* that was burnt 3 Nov. 1777, which was restored with a new roof; 1628 the entrance in the new piazza del Mercato, now Nuova, was made; S. Cantone (not Carloni) put a fresh front on an Ionic over a Doric order to the building 1778; the edifice has become the courts of law, and has recently been much altered: the adjoining archivii regi, formerly the palazzo criminale, rebuilt 1641: the loggia dei Banchi or exchange, 110 ft. long by 60 ft. wide, 1570-96, attributed to G. Alessi, restored 1732 and 1752, and remarkable for a roof wholly formed of wrought iron which deserves examination as anticipating the light iron roofs lately introduced in England: the palazzo della Compera (the celebrated bank) di S. Giorgio, built by Fra Oliviero di S. Andrea di Sestri 1262, enlarged 1293, 1368, and 1407, restored 1535, and enlarged 1571, with three pointed archways in front, is the dogana or custom house; the hall, now serving as the *long-room*, was one of the finest saloons in the world, being decorated with statues in two ranges, the lower of seated figures and the upper of erect portraits, of the founders of charities in Genoa; these in 1844 were taken away and cleaned, before placing in the new façade towards the terrace: and the zecca or mint 1736, formerly the *pubblici forni*.

It is necessary to notice that the churches have had their names changed to a greater extent than perhaps in any other city; the present titles are given above, but the mutations may be learnt from the MS. map by Accinelli, 1769, in the royal library at the British Museum; the *Descrizione*, 8vo., 1846, which, iii, 213, gives a list of the doges of Genoa; the *Manuale*, 16mo., 1846; ALIZERI, *Guida Artistica*, 12mo., 1847; and RATTI, *Istruzione*, 8vo., 1780. The last named work gives a list of eighty-six *palazzi* which have, in many cases, undergone more than one change of title: indeed the local maps and guidebooks, with RUBENS, *Palazzi Antichi*, and *Palazzi Moderni*, fol., Antwerp, 1622-63, if compared with GAUTHIER, *Les plus beaux édifices de Gènes et ses environs*, fol., Paris, 1818-32; and the map in the *ATLANTE GEOGRAFICO*, fol., 1844, form a riddle which would require careful work extending over several days to solve upon the spot. The French work gives twenty-six of these structures, in addition to thirty-one engraved by RUBENS.

The palazzo reale (a name formerly given to the palazzo ducale) in the strada Balbi, was designed by P. F. Cantone and G. A. Falcone for one of the Durazzo family. The other palazzi in the same street are by B. Bianco, the Durazzo at the north-east corner has the celebrated stairs by Tagliafico; the next Durazzo was restored by N. Laverneda; the Balbi and Balbi Piovera were finished by P. A. Corradi. G. B. Castello did the Cataldo in the strada Nuova, and the Imperiale in the piazza di Campetto; Gregorio Petondi did the façade of the Balbi, at the corner of the via Lomellini and the via Nuovissima; D. Cervetto, succeeded quickly by Ippolito Cremona, began 1820 the Farragiana in the piazza dell' Acquaverde; and a great number of the others including the Centurione in the piazza de Fossatello which could not be the work of Alessi, as it was not commenced till 1612, are ascribed to that architect, and are mentioned s. v. G. ALESSI.

Among the educational establishments are the university, by B. Bianco, 1623-42; the six scuole di Carità, that of Gesù e Maria with a church built 1589, and that of S. Bernardo with a church built 1627; the seminario arcivescovile, enlarged 1840-2 by Ignazio Gardella; the collegio di marina, formerly

the nunnery of the Teresians, 1619; and the accademia di belle arti by C. Barabino.

The theatres are those of S. Agostino (timber) for 2,000 persons; Falcone, for 1,000 persons, by A. Falcone in the seventeenth century; delle Vigne (timber) for 500 persons; Carlo Felice (given in GAUTHIER), begun 19 March 1826 on the site of the church of S. Domenico, by C. Barabino, who completed it 7 April 1828, its portico is hexastyle of a Greek Doric order with columns of Carrara marble 34 ft. 6 ins. high, the interior holding 3,000 persons has a horse-shoe plan 60 ft. wide by 65 ft. long and 55 ft. high; and Diurno, 95 ft. in diameter, by Luigi Prato 1830 for 3,000 persons.

Passing along the town from east to west, the chief works not noticed above are the aqueduct of Tresasco, continued 1226-95 by Boccanegra, and lengthened 1622-36 and 1782, when the syphon 2193 ft. 7 ins. in length was formed of cast iron pipes 14½ ins. diam., *AQUEDUCT*; the viaduct, called the ponte di Carignano, from the church of Sta. Maria to the piazza Sarzano, which was commenced 1718 by G. Langlade, and finished 1724, passing over houses so much as seven stories in height; the *mandraccio* or old dock, completed 1276-8 by Boccanegra; the old mole, continued by him 1283, lengthened 1300-6, 1470 by A. Siciliano, 1492, 1553 by Alessi, 1728-38, 1778, and 1841; the *porto franco* or pile of three hundred and fifty-five bonded warehouses, built 1642, and having two stories respectively 20 and 17 ft. high; the portico 1830 along the strada Carlo Alberto; the palace of the Admiralty, now the hotel Feder; the albergo della Croce di Malta, formerly belonging to that order; the palazzi Grimaldi and Fieschi, converted into the hotel d'Italie; the strada Ronda 1641 by the younger Aicardo; the *darsena*, commenced 1275 (not 1215 as in SOPRANI), finished by M. Boccanegra and A. Siciliano 1283; enlarged by Alessi 1552, and continued by the younger Aicardo; the palazzo Fregosi or Doria Panfilì at the porta di S. Tommaso, given by GAUTHIER; the slate quarries; the new mole by the same Aicardo 1638, lengthened 1651 by Bianco, and 1668, and its lantern or lighthouse; given in the same work, which also includes six villas or rather palazzi at the suburb of S. Pier d'Arena, with others at the localities just outside the town called the Lerbino, Cornegiano, Sestri di Ponente, and Albaro, which are well worth attention; indeed the numerous cascade on the hills and the handsome villas in the Riviera afford plenty of subjects for study during a lengthened visit to Genoa. Large views of the city are given in GAUTHIER; and, with some interesting street views, in the volume of plates published towards the end of the last century by GUIDOTTI.

GENTISE appears to be a mis-reading by some writers of the word GENLESE, as read by WILLIS.

19. 22.

GENTLEMAN'S ROOM. An apartment in a large residence devoted specially to the uses of the master, and sometimes to the male portion of the occupiers. In the one case it is often called "the study"; in the other, it is the place where guns, whips, etc., are kept, and smoking permitted.

GENTZ or GENZ (HEINRICH), erected about 1794-1800, the principal or new mint (haupt münze) at Berlin, No. 7, Werder markt, on the site of the hotel de ville burnt in 1794. He became oberhofbauinspektor, and professor of architecture in the academy in the same city, where he died 1811. The mausoleum at Charlottenburg by Schinkel is sometimes attributed to him.

68.

GENUA, see GENOVA.

GEOFFREY (MASTER). The Pipe Rolls 20 and 21 Henry II (1173-5), contain orders for payments to him, and "by the frequent connection of his name with the works at Windsor Castle, he must have been either the superintendent or master builder"; TIGHE and DAVIS, *Windsor*, 8vo., 1858, i, 32.

GEOLOGY. The science of the varieties of the strata of which the earth is composed, and of the various causes which have been and are in progress to alter the face of the earth. The sciences of Mineralogy and Palæontology are intimately

connected with Geology. A general view of the subject is sufficient to enable the architect to judge of two material points in any situation, viz, the probability of obtaining a supply of water, and the character of the building materials upon the spot or in the neighbourhood. The influence of the geological structure of a district upon the general character of the scenery, tastes, and habits of the population, and upon the style of architecture usually prevailing in it, are subjects worthy of attention. These have been well considered in WILKINSON, *Practical Geology and Architecture of Ireland*, 8vo., London, 1845. Among the most useful treatises on Geology are ANSTED, *Geology*, 8vo., 1844; and *Elem. Course of G. and Miner.*, 8vo., 1850; LYELL, *Manual of Elem. G.*, 8vo., 1857; and *Principles of G.*, 8vo., 1853; HUMBLE, *Dict. of G.*, 8vo., 1840; PAGE, *Introductory Textbook of G.*, 5th ed., 8vo., 1861; *Advanced Textbook of G.*, 2nd ed., 1859; and *Handbook of G.*, 8vo., Edinb., 1859; DE LA BECHE, *Geological Observer*, 8vo., 1853; PHILLIPS, *Manual of G.*, 8vo., 1855; JUKES, *Student's Manual of G.*, new edit., 8vo., 1862; PORTLOCK, *Rudimentary Treatise of G.*, 12mo., 1853; MORANT, *Geological Chart*, showing the order of superposition, etc., and uses of the various stratified rocks, large sheet, 1854: BEUDANT, *Cours élémentaire de G.*, 8vo., Paris, 1841; DEXMIER, Viscomte d'Archiac, *Histoire des progrès de la G. de 1834 à —*, in progress, 8vo., Paris, 1847, etc.; DE MANET, *Cours de construction professé à l'école militaire de Bruxelles*, 8vo. and fol., Brux., 1847-50; BURAT, *G. appliquée*, 2nd ed., 8vo., Paris, 1846; D'ORBIGNY ET GENTE, *G. appliquée aux Arts*, etc., 8vo., Paris, 1851.

Various specific information will be found under CHALK; CLAY; DOLOMITE; LIMESTONE; MARBLE; OOLITE; SANDSTONE; SLATE; STONE; etc.

GEOMETRICAL DRAWING. The representation of a solid or solids in plan, elevation, or section, or by one or more of them in outline, to which shadows, carefully projected, may be added, and which may have the assistance of local colour in further elucidation. It is remarkable that delineations in perspective, are not included in any definition of this term, which in a very restricted sense is applied to the process of dividing or setting out work upon a base furnished by a geometrical figure or figures, as by a square and a circle, by overlapping triangles, etc.

GEOMETRICAL ELEVATION. The vertical ichnography or orthographic projection of the various fronts of a building. The term is generally used in contra-distinction to perspective elevation.

A. A.

GEOMETRICAL POINTED ARCHITECTURE. The introduction of a new term for a style between the Early English and the Decorated of RICKMAN was proposed 1842 by FREEMAN, and advocated by PALEY, *Manual of Gothic Architecture*, 12mo., London, 1846, p. 29, for the date 1270-1330; as well as by POOLE, *History of Ecclesiastical Architecture*, 8vo., London, 1848, p. 237, for the date about 1250-1300. But SHARPE, in July 1848 (*ARCHÆOLOGICAL Journal*, 1852, ix, 170), and in the paper entitled *Geometrical Period* in the *BUILDER Journal*, 1848, vi, 386, 400, as well as in his *Treatise on Decorated Windows*, 8vo., London, 1849, assigned the years 1245-1315 for its range. The subject forms great part of the matter of a discussion in the *BUILDER Journal*, 1851, ix, 356, 464, 702, in which FREEMAN, p. 431, says "Geometrical and Flowing are so mingled together in individual instances, that for describing particular buildings we want a threefold nomenclature, and for this purpose I see no reason whatever for departing from that of Rickman, which is sanctioned by general use"; and when stating, p. 513, that he would not be understood to say that the distinction between Geometrical and Flowing exists only in the tracery, this author seems to confirm the grounds of the proposal made 1850 for a division of the period of Geometrical Pointed Art, as the style of the latter half of the thirteenth century, into Concentric and Eccentric. This is due to

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POOLE, who, objecting to the Geometrical being called either Late Early English or Early Decorated, asserted in the *Reports*, etc., of the Associated Architectural Societies, 1850, i, 65 (reprinted without illustrations in the *CIVIL ENGINEER Journal*, 1850, xii, 382), and in the *ARCHÆOLOGICAL Journal*, 1850, vii, 94, the existence of characteristic details between the Late Early English and the Geometrical, and between the Geometrical and the Early Decorated.

COX, in the *ECCLÉSIOLOGIST Journal*, 1852, xiii, 119, expressed his view of "the entire difference of principle discernible between the Geometrical style and those which succeeded it; — all Gothic architecture he classed into two chief styles or divisions; the characteristics of the former of which are the distinct existence of every part in the formation of the whole; harmony the result of subordination, not the extinction of the parts; and of the latter, the fusion of all the component parts together, so that nothing now retains a separate individual existence; all is here not subordinated to, but lost in, the effect produced by the whole. This line, which can never be passed, cuts off all Gothic architecture which makes use of pure Geometrical forms, from that which employs those of a continuous character, be they flowing or rectilinear."

INKERSLEY, *Inquiry*, etc., 8vo., London, 1850, uses Secondary Pointed and Geometrical Tracery as synonymous with the Decorated style in France. **GEOMETRICAL TRACERY.**

GEOMETRICAL PROPORTION or RATIO. An algebraical term for magnitudes which bear the ratio of certain multiples to one another. In architecture it is used where parts of a building bear the before described relations to one another. Thus a room 40 ft. long, 30 ft. wide, and 20 ft. high, would be said to be in geometrical proportion, each of these numbers being multiples of the number ten. Where it can conveniently be done, it is well to design in these ratios, as the regular subdivision of the parts becomes more easy. Rules have been given by many authors, particularly by PALLADIO and CHAMBERS. In another sense it has been used to express a design where the various points fall on the angles of regular geometrical figures, as equilateral triangles, etc., as shown in some of the books mentioned *s. v.* **GEOMETRICAL TRACERY.** Attempts have been made to show that the plans and sections of mediæval structures were set out on such figures, but on applying those forms to plans of existing buildings, the points fall sometimes on the internal, sometimes on the external, boundaries; and sometimes on the projections of the buttresses, even if they coincide at all. **INTERAXIAL DIVISION; PROPORTION; SYMMETRY.**

A. A.

GEOMETRICAL STAIRCASE. The term commonly applied to stone staircases radiating on their plan from one or more centres, with an open well; the broadest end of each step being tailed into the wall and resting on the next below it by a back rebate as in straight staircases, and having in addition to these two elements of strength a third, viz. that derived from the keying character of each step with reference to the adjacent ones above and below it. That geometric staircases possess in their construction three distinct elements of strength, which when combined are of great value, may be proved thus: with reference to the first (the tailing), it is not only practicable to load considerably a single step tailed 6 ins. into a solid wall, the wall being of adequate height to resist the leverage, and the strength so derived will be equal to half the breaking weight of the material itself; but it is also practicable to take out a broken step from the middle of a flight without injury to those above or below it, only shoring up the parts immediately contiguous during the operation.

With reference to the second element (the back rebate), it has been proved by careful experiment that while a step of a certain kind by itself broke with a load of 5 cwt., another, in all respects of the same kind and character, when supported along its length by the back rebate upon another resting on the ground, bore upwards of five times that load

without breaking. Then for the third element, it must be obvious that the plane of a circular or elliptic staircase partakes of the nature of a winding cylinder, whose every part resists the other and so contributes to mutual support; as in the case of skew arches, where the stones, though not opposed to each other on a parallel plane and for their whole depth (as in a common arch), do so for the depth of the back rebate; and therefore the deeper that part is made, the stronger both in material and construction the staircase will be.

These staircases have always been greatly admired. PALADIO, b. i, ch. 28, quotes two examples upon which many varieties and combinations have been erected with general success. They might, therefore, be considered safe and particularly applicable to dwelling houses, where their light and graceful form is calculated to impart much cheerfulness to an interior. It has lately been urged by official persons, that in future all staircases of public resort should have vertical support at both ends of the step, thus ignoring the use of geometric staircases for public, if not for private use; and this caution may be reasonably exercised in regard to such staircases exposed to the risk of having many persons crowded upon them in a state of excitement, as through an alarm of fire; or exposed to the influence of any extraneous causes, such as the carrying up and down of heavy loads; the frequent use of explosive materials; the continual stroke of a steam engine, etc., etc.; which may in the course of time contribute not only to disintegrate the material itself, but eventually disclose any concealed defect in the execution of the general work, and be attended with serious consequences. The failure at the Polytechnic Institution in January 1859, of a geometrical staircase erected twenty years previously, was due to such defects. It may be further remarked, that the effects of jarring on staircases of this construction may be seen by examining the soffits of the principal staircase at Somerset House, formerly used by the Royal Academy, which are much fractured; as well as the celebrated geometrical staircase by Sir C. Wren at St. Paul's cathedral, many of the steps of which are seriously broken, so that it has been closed against use by the public for many years. VICE. J. T.

The term has also been defined in a less restricted sense, namely as a staircase in which the flight of stairs is supported by the wall at one end of the steps. 1.

GEOMETRICAL TRACERY. This subject, originally glanced at by RICKMAN, *Attempt*, 8vo., London, 1835; and subsequently by PETIT, *Remarks on Architectural Character*, fol., Oxford, 1846, furnishes in great part the matter to SHARPE, *Treatise on Decorated Windows*, 8vo., London, 1849; and more to FREEMAN, *Essay on the Origin and Development of Window Tracery*, 8vo., London, 1851, who, dividing the subject into "Early Geometrical Tracery" and "Arch Tracery", observes, p. 83, that "among all its countless varieties, there is still a great unity of idea; the purer and more satisfactory the design, the more closely does it set forth the principle of distinctness of parts, of an unity produced by mere design and composition, and not by actual fusion or combination of the parts among themselves. The mullions still form one design, the tracery in the head another; the purer the style, the more distinct are they; they might be conceived as existing separately; we might carry off the centre-piece of many a splendid geometrical composition, and set it up by itself as an independent circular or triangular window. The parts still continue merely to support and be supported, but not to grow out of each other; they simply touch at various points, and leave many spaces unoccupied; and the purer the style, the more do these unoccupied spaces remain to bear witness to the complete distinctness of the parts between which they lie." And the same author, after remarking that to fuse the parts together by foliation (*i.e.* by actual foliation of the space, not by insertion of a foil figure in a spandril) is at once to desert the principle of the style, devotes the pp. 84-146 to the transition from Geometrical to Flowing Tracery.

BILLINGS, *Illustrations of Geom. Tracery from—Carlisle Cath.*, 4to., 1842; *Geometric Tracery of Brancepath Church*, 4to., 1845; *The Infinity of Geometric Design Exemplified*, 4to., 1849; and *The Power of Form applied to Geometric Tracery*, 8vo., 1851. **GEOMETRICAL POINTED ARCHITECTURE.**

GEORGIAN ARCHITECTURE. The name of Georgia is now given by the Russian authorities to the whole territory possessed or claimed by them south of the Caucasus; but the true Georgia, or Iberia (Pers. *Gurdschistan*; Russ. *Grusia*), occupies about half that extent of country, and is situated in the centre of it. The peculiarities of the Byzantine, Armeno-Byzantine, and Georgian architecture are to be sought in the works by BESSE, *Voyage en Crimée*, etc., 8vo., Paris, 1838; DUBOIS DE MONT-PEREUX, *Voyage autour du Caucase*, Paris, 1843, whose accuracy is attacked by WILLIAMS, *On Eccles. Arch. in Georgia and Armenia*, printed in the *BUILDING NEWS Journal*, 1862, vi, 368, 383, 399, but is certified by BROSSET, *Rapports sur un Voyage*, St. Petersburg, 1851; upon which the *ECCLÉSIOLOGIST Journal*, 1852, xiii, 5, 223, reviewing NEALE, *Hist. of the Holy Eastern Church*, remarks that the plan of the cathedral at Koutais in the later *Voyage* differs from that in the *Rapports*. The leading buildings not purely Byzantine are those at Okhvame in Abkhazia (tenth century with a pointed arch); Koutais in Imeretia by Adgomba Maisa, 1003; Chakhboulak in Karabagh, and Martvili by Mikael Ouplari in Mingrelia (eleventh century); Catzki, and Nikortsinda, in Imeretia (twelfth century); Khopi in Mingrelia, 1384-96; and Ananour, 1614-34.

GERACE. A small city, in the province of Calabria Ulteriore in Italy, which was almost destroyed 1783 by an earthquake. The cathedral, dedicated to the Assumption, was rebuilt, or rather restored 1818-34, and the episcopal palace has been in great part rebuilt. The lower portion of the cathedral, which possesses a great number of columns brought from the neighbourhood of an aqueduct and of a mediæval tower on the sea-shore recognized as the site of the ancient Locris or Locri Epizephyrii, was of Norman work, and possessed some interest in its crypt and in the altars, made of mosaic like those of the church of S. Francesco. The ruins of a Norman castle, on a sharp crest of rock which has three sides quite perpendicular, ten other churches, two monasteries, a nunnery, the seminary, and the hospital, are the chief other buildings. 28, 96.

GERANOS, with its diminutive GERANION. The Greek name for a crane, which seems to have been the machine used for lifting weights, and especially for raising the actors from the stage of a theatre.

GERASA. The ancient name of a city, destroyed in the time of Vespasian and now called Djerash or Jerash in Syria, which almost ranks with Baalbec and Palmyra in the extent of its ruins, and of its necropolis. From the latter, which contains numerous interesting sarcophagi, a double range (about a mile in length) of columns formed a street running to the south, where it met a large semicircular colonnade of an Ionic order, a small temple, a theatre, a naumachium, and a triumphal arch of a Corinthian order. This double range was intersected by three streets, each possessing important structures, inclusive of a temple of a Corinthian order with two ranges of columns in front and a single row on the other sides erected about 138-61 A.D. The remains have been illustrated in eight plates by LABORDE, *Voyage en Orient* (Syrie), fol., Paris, 1838. 28.

GERBIER (SIR BALTHAZAR), born at Middleburg in Zealand 1591, was in England in 1617, if not as early as 1613, where he made his attendance pleasing to the duke of Buckingham (in whose household he held office as master of the horse), on account of his "several languages, good hand in writing, and skill in sciences—as mathematics, architecture, drawing, painting, contriving of scenes, masques, and entertainments for great princes; besides many secrets gained from divers rare persons; as likewise for making of engines useful in war." He was knighted at Hampton Court 2 Oct. 1638 (at Greenwich 31 March 1629 is generally stated), and was ap-

GENOVA



STRADA NUOVA

Sketches by E. W. Coode A.I.A.



pointed master of the ceremonies 10 May 1641. Shortly before 1628 he built a banqueting room for himself, near the water gate at York stairs, 35 ft. square, much commended by the king; designed 1661 four triumphal arches for the coronation (not restoration, as generally stated) of Charles II, placed at Leadenhall-street, Cornhill, Cheapside, and Fleet-street (given in OGILBY, *The Entertainment*, etc., fol., London, 1662); and designed Lord Craven's house at Hempstead Marshall, Berkshire, 1662 (given in KIP, *Brit. Illust.*, fol., London, 1714-20, pl. 45), it was continued by his pupil Capt. William Wynde, as Gerbier died 1667, and was buried in the chancel of the church adjoining: the house was destroyed by fire 1718, and was commenced rebuilding by Gibbs. He himself mentions a design for a gate at Temple Bar presented to the king.

Among some twenty-four pamphlets published by Gerbier, the following only are of professional interest: *A Brief Discourse concerning the Three Chief Principles of Magnificent Building*, 12mo., London, 1662, and again in 1664; reprinted in the *Detached Essays*, 1848, to which is added part of the *Counsel and Advice to all Builders*, 12mo., London, 1663, and again 1664; observations on this latter work were read by S. SMIRKE, R.A., at the Royal Inst. of Brit. Architects, *Transactions*, 1848-9; reprinted in the *BUILDER Journal*, vii, 146, 158-9, and *CIVIL ENGINEER Journal*, xii, 153. In the preface to the first named work he states that "the place of surveyor-general was intended to me (after the late Inigo Jones)"; but he did not hold that office. An engraved portrait is prefixed to his work *The Interpreter of the Academie*, etc., 1648; there is another by Pontius after Vandike; he is represented (formerly stated to be Inigo Jones) with Sir C. Cotterel and Dobson, in a picture by the latter at Northumberland house; and a picture of himself and family, by Vandike, is at Windsor Castle (WALPOLE, *Anecdotes*, Wornum's edit., 1849, 281; and *ATHENÆUM Journal*, June 28, 1862, 858). Memoir in the *Detached Essays*; *Calendar of State Papers, Domestic Series*, 1660-62, 8vo., London, 1860-1; SAINSBURY, *Original Papers, P. P. Rubens*, 8vo., London, 1859; and *NOTES AND QUERIES Journal*, 4to., London, ser. 1, ii, iii; ser. 2, viii, 121-2, 195.

GERBRANDS (LOUIS) was employed 1449 on the town hall at Gouda. AELBRECHTS. 24.

GERENZIA or CERENZA (the latin Geruntia). A town in the province of Calabria Ulteriore in the kingdom of Naples. The church, formerly cathedral, dedicated to S. Teodoro, and two monasteries, are the only structures of note. 96.

GERF HOSSAYN, in Nubia, see TUTZIS.

GERLACH (PHILIP), born 1679 at Spandau, was a pupil of Broebes. He became major of engineers, oberbaudirektor, and privy councillor at Berlin, where he completed 1707-15 the tower of the parochial-kirche by adding the two upper stories; added to the great Friedrich's-waisen-haus, or orphan asylum, its church and tower; enlarged 1722-36 the Friedrich's-stadt; designed 1726-8 the Jerusalem-kirche, and 1731 its tower with an upper story in wood which has rotted; 1734 the collegien-haus or kammer-gericht in the Linden-strasse; and the Garnison-kirche with its tower in Berlin, which city owes much of its beauty to the private houses designed by him. Amongst his other works were the Garnison-kirche with its tower at Potsdam; and the markt at Koslin. He retired 1737 from the service, and died 1748 at Berlin. 68.

GERMAIN (THOMAS), born 15 August 1673 at Paris, was son of the goldsmith Pierre Germain. Being left an orphan at eleven years of age, he applied himself so earnestly to drawing that in two years he obtained a medal in the Academy of Painting, and was sent to study at Rome. He designed a church, supposed to be that of the Armenians, at Leghorn, and returned to Paris, where he resumed the paternal business. The church called S. Louis du Louvre, erected for cardinal Fleury 1740 on the site of that of S. Thomas du Louvre, about 64 ft. long by 42 ft. wide, is given in BLONDEL, *Arch. Franç.*, fol., Paris, 1752, iii, 63. He died 14 August 1748, and was

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buried in the chapel that seems to have been assigned to him as the remuneration for his design. 68.

GERMAN ARCHITECTURE. The extent of country subject to the influence of the styles and of the artists that will be noticed in this article, is marked on the west by Embden, Xanten, Aachen, Trier, Metz, Strassburg, and Basel; on the south by Bern, Botzen, Villach, Laybach, Agram, and Fünfkirchen; on the east by Pesth, Cracow, and Warsaw; and, properly, on the north by Königsberg, Danzig, Hamburg, and Bremen, though reasons will easily suggest themselves for extending the limit to Trondhjem, Upsala, and Riga. The few remains of Roman art existing in the south portion and on the Rhine, have as little importance in this instance as the pretended Merovingian Ruperts-kapelle at Salzburg, the Marien-kapelle at Würzburg, or the supposed Carolingian crypt under the propsteikirche at Fulda. The certain era of modern German architecture commences with Charlemagne's importation 796-804 of Byzantine artists, whose taste became traditional around Aix-la-Chapelle and on the Lower Rhine. The original portions of the round church (finished 822) upon the Michaelsberg at Fulda; of the churches dated 824 by some authors in the island of Reichenau near Constanze; the early part of the stiftskirche (874) at Essen; the ruins at Mettlach on the Saar; the porch at Lorsch near Worms; the crypt of S. Wipert at Quedlinburg; the round church at Ottmarsheim; and part of the abbey at Corvei; may be mentioned as belonging to a style that has not received any definite appellation, and which is neither Byzantine nor Romanesque, as the latter term is applied by the German archaeologists. These authors differ as to the dates of the buildings: thus while some consider Lorsch to date about 878, KUGLER and SCHNAASE ascribe it to the early part of the twelfth century; KUGLER dates the nave of the cathedral at Mainz 1009-37, but VON QUAST believes it was built after the fire of 1137; SCHNAASE dates the cathedral at Speier 1030-1106, but KUGLER and MERTENS think that it was built after the fire of 1159; KUGLER gives the date 994, but WAAGEN 1065, to the western portion of the cathedral at Augsburg: while, as in other countries, dates are entirely wanting to many of the most interesting buildings, which in the lists given by OTTE have no other description than Early (or pure) Romanesque, Late Romanesque, and Transitional. To these terms he adds Early, Decorated, and Late, German architecture; so that his nomenclature, divided under the heads of *Rundbogenstil* and *Spitzbogenstil*, embrace six divisions. *Früh* (or *streng*)-*Romanischerstil*, *Spät-Romanischerstil*, *Uebergangstil*, *Früh-Germanischerstil*, *Ausgebildet-Germanischerstil*, and *Spät-Germanischerstil*; the three last respectively he fixes in the thirteenth, fourteenth, and fifteenth centuries.

The following list of remarkable works includes only those which appear to have ascertained dates. The abbey at Corvei was continued during the tenth and eleventh centuries; at the end of the latter period were erected the churches at Höchst am Main, and at Bursfelde an der Weser. In the twelfth century examples are to be sought at Lütlich, Hirzenach, Johannisberg, and Mittelheim. In the thirteenth century the Transitional style first appears with a certain date, in the polygonal nave of S. Gereon at Cologne 1212-27; and of the cathedral at Limburg an der Lahn 1213-42. The church at S. Thomas 1225 is almost complete Gothic; but the Romanesque character is maintained so late as 1269 in the Liebfrauenkirche at Coblenz; and as 1304 at Lewetzow. So that contemporaneously with these works existed the EARLY GERMAN style in the churches of the Liebfrauenkirche at Trier 1227-44, and S. Elizabeth at Marburg 1235-83, which extended so far into the fourteenth century as 1333 at the Adalbertskirche in Breslau. As models for the work of that century may be cited the Barbarakirche at Kutenberg 1300-1419; the Marienkirche at Colberg 1316-1410; the Marien-kirche at Bamberg 1327-87; the cathedral at Frauenburg 1342-50; and the Heilige-kreuzkirche at Gmünd 1350-1410.

To the fifteenth century belong the Franciscan monastery at Andernach 1414-63; the cathedral at Berne 1421-1502; the churches at Nordlingen 1428-1505; at Danzig 1430-1515; at S. Goar 1441-69; at Grätz 1443-60; at Stuttgart 1444; at Dinkelsbühl 1444-99; at Bruchsal 1444; at Ribnitz 1458; at München (cathedral) 1468-88; at Schwabach 1469-95; and at Wimpfen 1494. The style lasted much longer, for the latest buildings to which reference can be made without notice of the *style de la Renaissance* are the churches at Zwickau 1453-1536; at Alt-Krüssow 1520; at Halle an der Saale 1523; at Anspach 1530-50; at Friedenstadt (in the *style perrique*, 'zopfstil') 1601-8; and at Coblenz (the Georgskirche) 1618.

The extent of the field to be surveyed in this article renders it necessary for the reader to remember, the periods at which Christianity began to influence certain portions of it, and also the places from whence the artists or the fashions may have been obtained. There is, however, so great a difference between the works of Pointed architecture in the western portion of the country and those in the eastern, that KUGLER, *Handbuch*, 8vo., Stuttgart, 1848, p. 586, says "the Germanic style is developed in a peculiar manner on the coasts of the Baltic, and in some of the adjoining districts of Germany, viz. Holstein, Mecklenburg, Pomerania, the old and new Mark Brandenburg, Prussia, Courland, Liefland, and also in the Scandinavian countries"; to which may be added the Küstenland between the Oder and the Elbe, and Lower Saxony, west of the Elbe. Some illustrations are given in KUGLER, *Kleine Schriften*, 8vo., Stuttgart, 1855, i, 652-835, in the article entitled *Pommersche Kunstgeschichte*. This subject has been treated by C. FOWLER, jun., in a paper entitled *The Mediæval Brick Buildings in the North-East of Germany and on the Coast of the Baltic*, read 18 February 1850 at the Royal Institute of British Architects, and partly printed in the *CIVIL ENGINEER Journal*, xiii, 128. The employment of bricks as the material for Gothic buildings is to be seen around München; Breslau; Frankfurt an der Oder, with Fürstenwalde (where the Marienkirche has been once burnt), and Gnesen; Brunswick, Hanover, Verden, Lüneburg, Lübeck, Gadebusch, and Stralsund; Danzig, and Frauenberg; Copenhagen, Roeskilde, and Frederiksborg; and Stockholm with Upsala. The gate towers at Brandenburg and Stenthal are remarkable examples dating about 1400. The style of Gothic said to be peculiar to the Baltic is seen in the brick castle of Marienburg near Danzig; it seems to deserve comparison with the plain Gothic that prevailed, with few exceptions, in the old edifices constructed in Denmark, inclusive of the castle of Frederiksborg, built 1606-20 by Heenwinkel, and burnt 1859. This fortress was, indeed, one of the latest Gothic works to be found in the countries to which this article refers: modern Italian art was first introduced into Germany perhaps at Innsbruck 1553; and after 1575 Germany, within the limits above named, was in the hands of architects who showed no favour to a Pointed style; for example, the old palace at Munich was designed 1575-1616 by P. Witte, a pupil of Vasari; and Italian teaching is visible 1574-8 at Rothenburg, and 1600 at Nuremberg.

For a list of the men who are known to have been employed in the construction of the ecclesiastical buildings of the Gothic period in Germany, reference may be made to OTTE, *Handbuch der Kirchlichen Kunst-Archäologie*, 8vo., Leipzig, 1854, pp. 170-76. The stiftskirche at Wimpfen im Thal, built 1262-78, is noticed by a contemporary chronicler as erected 'opere francigeno', a hint that the Pointed style was derived from France, OTTE, p. 110; Etienne de Bonneuil was engaged 1287 at Upsala; Mathieu d'Arras 1334 at Prague, and 1348-53 at Karlstein, had also been borrowed from France, as Aristotele Alberti, employed 1455-85 in Hungary and Russia, had been obtained from Italy; DUSSEUX is wrong in considering P. Arleri, employed 1357 at Prague, as a native of Boulogne, he may have been born at Bologna, but is found recorded as 'de Polonia'. Yet, as observed by GWILT, *Dict.*, Germany

claims to have lent her architects to other countries. While Spain acknowledges its reception of John and Simon of Cologne at Burgos, Miraflores, and (perhaps) Barcelona, Italy cannot deny having obtained the professional assistance of the German Johann von Innsbruck 1174 at Pisa; Jacob 1228-30 at Assisi, and 1275 at Arezzo; Heinrich Ahrler of Gmünd 1386, Johann Annes of Fernach 1391, Ulrich von Frissengen of Ulm 1394, and Johann von Gratz of Strassburg with others 1483, at Milan; as well as Peter with Christopher von Freiburg 1402 at Orvieto. After that period German art does not seem to have been in request abroad: indeed the Austrian dominions received several Italian architects, and a few entered the Prussian service, but the other states were chiefly furnished with architects by France until the Revolution. The names of the native and foreign architects chiefly employed in the Austrian dominions may be gathered from TSCHISCHKA, *Kunst*, 8vo., Vienna, 1836; in Bohemia, Moravia, and Silesia, from DLABACZ, *Allgemeines Historisches Künstler Lexicon*, 4to., Prague, 1815; in Poland from CHODZKO, *Histoire de la Pologne*, 4to., Paris, 1855; in the Prussian territory from NICOLAI, *Beschreibung der Stadt Berlin*, 8vo., Berlin, 1786; and a good list of the French artists who practised in the countries considered in this article may be gathered from DUSSEUX, *Les Artistes Français*, 8vo., Paris, 1851.

For the titles of books upon the mediæval architecture of Germany reference may be made to the works mentioned in the notes to OTTE, especially KUGLER, *Geschichte der Baukunst*, 8vo., Stuttgart, 1859, ii, 302-592, iii, 203-512; SCHNAASE, *Geschichte der Bildenden Künste*, 8vo., Düsseldorf, 1844; MERTENS, *Die Baukunst des Mittelalters*, 8vo., Berlin, 1850; KALLENBACH, *Die Baukunst des Deutschen Mittelalters*, 8vo., Munich, 1847; ROSENGARTEN, *Die Architektonischen Stylarten*, 8vo., Braunschweig, 1857; and to WHEWELL, *Architectural Notes on German Churches*, 8vo., Cambridge, 1842, with a supplement in the *ARCHÆOLOGICAL Journal*, 1850, vii, 217-36, who (saying that the Early English style is found almost exclusively in England, at least does not occur in Germany; and more cautiously, p. 90, that the Early English style, as it exists at Salisbury for instance, was not developed in the same manner in Germany, and is not, in its most characteristic shape, to be found in that country) is obliged to allow the existence of a 'Transitional' or 'Early German' Art, agreeing with Early English in its clustered and banded slender shafts, its pointed arches, and its "mode of vaulting; but we do not commonly find, in the interior of the transition churches in Germany, the circular cluster of shafts,—the arches molded into a broad and deep mass of small rolls with deep hollows between,—the single lancet-headed windows, tall and narrow,—and the peculiar line of open flowers which is used so profusely in all Early English work. Nor do we observe, on the outside, the dripstone to the windows,—the molded or shafted window-sides,—the projecting buttress with its chamfered edge and triangular head,—the pyramidal pinnacles,—of our early cathedrals."

But with the exception of VOIT, GUILL, CASPAR, and LUEBKE, *Denkmäler der Kunst*, fol., Stuttgart, 1845-56, as the illustrations to KUGLER, *Handbuch*; and the *BAUZEITUNG Journal*, 1834 to 1862, it would be difficult to name any book in which a general view of the modern buildings of Germany may be found; and reference must be made to the titles given in this Dictionary at the end of the notices of the cities, as Berlin, Dresden, Hamburg, Munich, Vienna, etc., for works exhibiting the style of Chateaufort, Cuillers, De Thurah, Gaertner, Klenze, Knobelsdorf, Langhans, Nehring, Schinkel, and Weinbrenner, not to mention living architects. The nature of German architecture in the eighteenth century may be gathered from the books by STURM, editing GOLDMANN, 1716-52, PENTHER 1744-78, SUCKOW 1763, SCHMIDT 1790, and STIEGLITZ 1800, who in the *Encyclopädie der Bürgerlichen Baukunst*, 8vo., Leipzig, 1792, i, 215-23, has given a list of the publications then in vogue.

The imitation since 1815 of Pointed art, which has been chiefly applied to churches and country seats, is not entitled to favourable criticism: but due mention must be made of the bridge at Steinbrück over the Sann, and of the remarkable viaducts, viz. those on the line of railway between Vienna and Grätz; the Alpen viaduct near Immenstadt, between Augsburg and Lindau, 180 ft. high; the Elster viaduct, 228 ft. 6 ins. high; and the Göltzschthal viaduct, 263 ft. 6 ins. high, both between Reichenbach and Plauen on the road from Leipzig to Hof.

GERMANO (SAN). A town in the province of Terra di Lavoro in Italy. It deserves notice on account of some remains of Roman buildings; for a castle built before 1265; and the celebrated Benedictine abbey of Monte Cassino. The ruins mark the site of the ancient Casinum, and consist of a small square building called a temple or sepulchral monument of remarkable style, with four recesses or niches, and a roof arched as a cupola, constructed of travertine, now called the chiesa del Crocifisso, and not unlike in many respects the temple given in GAUTHIER, *Génes*, fol., Paris, 1818-23, ii, pl. 25, as belonging to the time of Proculus; of portions of a theatre built of reticulated masonry, and of a temple which, with the remains of a small amphitheatre that has lost its seats but still preserves its shape, has its erection ascribed to the liberality of Ummidia Quadratilla, in the time of Trajan. Nearly opposite to this last work are the ruins called the villa of Varro. In one of the churches are twelve marble columns, and outside another is a large stone vase dedicated to Hercules. The abbey, founded 509, at the top of a hill, on a site said to have been formerly occupied by a temple to Apollo, had a church which fell 1649, and was replaced by another 200 ft. long and 60 ft. wide exclusive of the chapels, which was consecrated 12 May 1727. The central doors of bronze covered with an inscription in letters of silver are said to date 1066. GATTULA, *Hist. Abbatie Cassinensis*, fol., Venice, 1734, ii, 736-48, gives an illustrated description of the place, and a fine view of the upper cloister of the monastery will be found in SAINT NON, *Voyage Pitt.*, fol., Paris, 1781-6, ii, 250. 25.

GERMAN SHEET GLASS. German glass of the last century was of two sorts, the white and the green; the first being of a whitish colour, but subject to those small curved streaks observed in the then Newcastle glass, though free from the spots and blemishes of it. The green, besides its colour, was liable to the same streaks as the white; but both qualities of glass were straighter and less warped than the Newcastle glass, and were sold at about the same price. The spread or German cylinder glass, imported into England from Belgium and other places, which preceded the introduction into England of the new French system, was unskilfully blown, cut open whilst hot with a pair of shears, and spread out immediately upon a plate of iron covered with sand; the surface was very coarse, and the thickness very irregular. It was of a much better quality than the French or BELGIAN GLASS, though sometimes called by the latter name; the latter, however, has lately improved. It has been said that it was about 1833 that sheet glass was made in England; the act of 38 George III, c. 33, 1797-8, mentions "sheet glass imported"; and that of 43 George III, c. 69, 1802-3, has "German sheet glass" as of home manufacture: Belgian workpeople seem to have been employed for it in this country. The chief difference between "spread or broad window glass" and "sheet glass", consisted in the fact that the former was blown in cylinders slightly tapering, whilst for the latter the cylinder was made of equal diameter throughout. By the act 1 and 2 Victoria, c. 44, 1837-8, the latter was not to be of greater thickness than one-ninth of an inch. Chance, in 1840, by polishing the thicker portions of German sheet, produced a superior article, which he called "patent plate", and which bears a close resemblance to British plate glass. A common sort of glass made in Germany, was chiefly sent to Nuremberg to be polished, thence into Holland, some being smuggled into England under the name

of Dutch glass. German glass is packed in small square boxes for exportation. GLASS; SHEET GLASS. 4.

GERONA (It. *Girona*; Fr. *Girone*). A provincial capital in Spain. The upper town is surrounded by a wall, but the military buildings have decayed; the houses are chiefly three stories in height; and the streets are well drained. The cathedral, dedicated to the Assumption, was commenced to be rebuilt 1316; the first architect of the new work seems to have been Henricus de Narbona, who was succeeded about 1320-2 by Jacobus de Favariis: while Guillermo Boffiy was architect, eleven other practitioners were requested 1415 to consider the prudence of having begun to alter the edifice, commenced as a single nave, into a nave with aisles. The opinions of each architect, given 23 and 24 January 1416, are printed by LLAGUNA, i, 261-74, who shows that the chapter decided to resume the completion of the work as a single nave. This, with chapels all round carrying a gallery of pointed small arches, measures according to the same author 259 ft. long to the middle of the presbytery, and 97 ft. in width, which is the width also of the great *perron* or flight of eighty-six steps in four flights of Pointed date, but the *Handbook* says 1607. The front, consisting of three superimposed orders, arranged so as to accommodate an elliptic west window, is finished by two hexagonal towers, the taller one serving as a campanile instead of the torre de Carlo Magno (on the south of the cloister), which is six stories in height with corbel tables of semicircular arches. The position of the choir (with stalls dating early in the sixteenth century) in the centre of the cathedral is considered as a defect by the Spanish critics, who extol the effect of the combination of the dome over the semicircular apse with the pointed arches that spring from the sides of the presbytery. The side with the rich *puerta de los Apostoles* is still incomplete. The capitular buildings date 1325, and the *patio* is remarkable for its marble columns of that period; the *galilea* and the *cimiterio de los Negros* are also noticeable. The collegiate church of S. Felix, formerly almost a fortress approached by a staircase between two polygonal towers, has three aisles divided by thick pillars, and the walls are formed by a continuation of them; the *coro* is in the middle of the nave; and it has an octagon campanile erected in the fourteenth century with simple pinnacles at the corners that enriched the base of a spire which was broken by lightning 1770-1800; the capitular buildings are not in a Pointed style. The church of S. Pedro, said to be in a Romano-Byzantine style, with a string of diamonded rustics all round the edifice, and having the *coro* over the *atrio*; two other churches; several chapels; four nunneries; one Carmelite monastery now used as government offices; and another serving as a warehouse for monopolized goods; the Capuchin monastery used as a school, and the Dominican monastery serving as the seminary; and a theatre copied from that at Barcelona, are the chief other edifices, as the churches with eight monasteries which were secularized were chiefly appropriated to the uses of the troops, and have been allowed to fall into decay. GAILHABAUD, *Arch. du V^e au XVI^e Siècle*, gives illustrations of the font (dating late in the sixteenth century) of a well, and of a Romanesque cloister, at the cathedral; and of the building called the *casa de los baños* in the garden of the Capuchin nunnery. GIRAUT DE PRANGEY, *Architecture des Arabes*, 8vo., Paris, 1841, p. 59, stating that the work of this *casa*, if it had been done by the Arabs, must date about 714-830, seems to decide that it belongs to the tenth or eleventh century. 66.

GEROPKIN (. . .) was the only Russian, except Semzoff, that appears to have profited by the study of architecture in Italy, for which purpose Peter I. supplied about 1717 funds to several of his subjects. On their return, both of those here named were employed upon churches and other public edifices. STAEBLIN, *Original Anecdotes*, 8vo., Lond., 1788, pp. 225, 299.

GERTENER (MADERNE), son of the mason Johann (both are found 1387 in a list of citizens) at Frankfurt-on-the-Main,

is said to have built several civic edifices in that city. The foundation stone of the new tower to the domkirche was laid 6 June 1415, and Gertener (called Matern Gartner by GRANVILLE, *Guide*, 8vo., Lond., 1835, i, 159-60) was engaged upon the works at a salary of ten florins a year and an annual gratuity of two florins. Three ancient drawings of the tower exist in the archives of the church, but these are by later artists according to PASSAVANT, *Kunstreise*, 8vo., Frankfurt, 1833, p. 431-8, who considers that Gertener probably died 1432, as in that year a Master Leonhard is termed the *werkmeister* of the building. 68. 92.

GERUSIA (Gr. *γερυσία*). The Latin form of the name of a building appropriated to the meetings of the elder inhabitants of a city, according to VARRO, *L. L.*, 8vo., Gottingen, 1833, v, 155, who says "senaculum vocatum ubi senatus aut ubi seniores consistent dictum ut gerusia apud græcos."

GESTATIO. This Latin word, originally meaning the act of bearing or carrying, became applied to the place in which a person took such exercise as was afforded by a litter carried by slaves or mules. Thus PLINY, *Ep.*, ii, 17, in the description of his villa at Laurentum, noticing the crypto porticus separating two suites of apartments (or as the French would say, a gallery with a pavilion at each end) which looked to the south-west over a xystus or flower garden to a lawn planted with fig trees and mulberry trees, adds that the lawn was surrounded by a pleached walk of vines, and that the whole of this pleasure-domain was surrounded by the *gestatio* fenced with box and rosemary.

GEVER. The Spanish mode, according to FORD, *Hand-book*, 1855, p. 174, of writing the name of Jaber, who is mentioned by that author on the authority of GAYANGOS, *Mohammedan Dynasties of Spain*, 4to., Lond., 1841-3, as the architect of the Kootsabea at Morocco; the smaller and unfinished one at Rabat; and 1196 that called the Giralda at Seville; and as erroneously reputed, from the coincidence of his name, to have been the inventor of algebra. The name is written Gever and Hever by LAGUNO, i, pref. 27, who gives the year 1000 for the date of the commencement of the Giralda.

GEYRA, GHERA, or GHEYRA. The ancient APHRODISIAS in Caria.

GEYST. A local way of writing Joist in 1532; SURTEES SOCIETY, *Finchale Priory*, 8vo., London, 1837, ccccxlv.

GHAT, often improperly written CHAUT. The name given in India to a pass in a mountainous range, and to a staith or landing place by the side of a stream. Perhaps Benares, of all the Indian cities, affords the best examples of stairs called ghats, as the face of that town, towards the river, is a continuous line of them, most of which have been erected by wealthy persons for the convenience of the public, not only as staiths for travellers, and as steps for the bathers, who frequent them in crowds without regard of sex, but as an ornamental wall preserving a natural or artificial bank from damage by the rise of the water and the heavy current consequent upon the periodical rains. Thus the most important at Benares, called the Gilsighat, which seems from the river to be a splendid building, is merely a beautiful façade; and the observer, after ascending the flight of steps, finds nothing behind it but the natural bank and a garden; in the centre of the façade and at each end is a pavilion or summer house.

GHEERYS (HERMAN) built 1444-87 the west end of the hôtel de ville at BRUXELLES.

GHENT in Belgium, see GAND.

GHERA or GHEYRA. The ancient APHRODISIAS in Caria.

GHETTO. The Italian term, sometimes said to be derived from the Hebrew *ghet*, division or separation, for the Jewry, or that quarter of a city in which alone Jews were permitted to dwell in mediæval times, or indeed so late as the middle of the sixteenth century, when the ghetto at Frankfort-on-the-Main was rebuilt nearly as at present; or as 1571, when the ghetto at Florence was prepared for the Jews by Buontalenti. The word

is perhaps derived from the late Latin *guetta*, a sentinel or watchman (thus the will of Philip the Fair, 1311, leaves "to Adam and Stephen our watchmen (*guettis nostris*) 60 shillings each"), for the ghetto was enclosed by gates, and guarded or watched to prevent the Jews going in or out during certain hours. DUCANGE, s. v. *Wactæ*. A. A.

GHIRO (BATTISTA), see GHISI or GHISIO (G. B.)

GHISI (GIOVANNI BATTISTA) seems to have been the same person as the G. B. Bertano whose life precedes in VASARI the notice of this G. B. (Ghisi) Mantuano as an engraver. He was born 1516 at Mantua, and was a pupil of G. (Pippi) Romano, on whose death he obtained a patent dated 12 May 1549 which made him the ducal architect with the charge of the cathedral in that city. The patent calls him (given in CODDÉ, *Memorie*, 8vo., Mantua, 1837, p. 160) Britannus, but Bertano appears on the titlepage of his work *Gli oscuri et difficili passi dell' opera Ionica di Vitruvio*, fol., Mantua, 1558, which existed in MS. in the possession of the earl of Burlington, and was translated into Latin by Polenius. The name is also found written Brixianus. Amongst his principal works are the completion of the cathedral (except some alterations specified by CODDÉ, p. 18), and of the palazzo Colloredo, in accordance with the designs left by his teacher: the church of Sta. Barbara 1562-5; with its four-storied campanile, considered at the time to be the finest in Italy, on which his name Bertanus and the date 1565 are inscribed: a portico or peristyle, of the Tuscan order, to the hanging gardens; the peristyle, of an Ionic order, to the garden of the *segretario*; with the external and internal cortiles of the palace: and a cortile opposite the church of S. Barnabas. He was made cavalier; and died 2 April 1576. Part of his commentary on VITRUVIUS is examined in BALDUS, *Scamilli impares*, 4to., Augsburg, 1612; and MILIZIA mentions the publication of a letter from Ghisi to Bassi concerning the disputes relative to the cathedral at Milan.

GHISI or GHISIO (GIOVANNI BATTISTA), called GHIRO (BATTISTA) by GAUTHIER, *Gênes*, fol., Paris, 1830, pl. 46, was a native of Torre, and a pupil of F. da Nove. He executed several churches and palaces at Genoa, where he died of the plague 1657, if not earlier. The Albergo de' Poveri in that city was commenced 1654 by A. Corradi, G. Gandolfi, and A. Torriglia in company with him, but the largest share of the credit due to the work is ascribed to this artist, who is called G. B. Ghisio in the *Descrizione*, 8vo., 1846, but G. B. Grigo in the *Manuale*, 16mo., 1846, by which name both those works designate the architect 1637 of the church of Sta. Maria di Consolazione.

GHIZEH, or GEEZEH, in Egypt, see MEMPHIS.

GHRENNAR in Tripoli, see CYRENE.

GHURBARIN is said to have constructed at Constantinople the column or obelisk 90 ft. high, covered with bronze by Constantine Porphyrogenitus, and to have been buried at the foot of it. EVLIYA, *Travels*, 4to., London, 1834, p. 19.

GIAFAR. An inscription dated A.D. 960 at Tarragona, ascribed the erection of the mosque, but probably of the mihrab only, to him. 66.

GIAFAR, perhaps the same as GEVER and HEVER.

GIALLO ANTICO. A fine yellow marble, of uniform colour, but with a few slight violet veins, which is supposed to have been procured by the ancients from Macedonia and from Numidia: six columns in the Pantheon and two in the arch of Constantine at Rome have monolithic shafts of this material: probably all marble now sold under this name is obtained from quarries in Italy, and would be more correctly described as GIALLO DI SIENA; the vendors, however, use the term for any yellow marble that has an exceedingly fine grain, and value the marble in proportion to the darkness of the tint. But as the tints vary considerably in colour and occurrence, the chief varieties seem to be *giallo carnigione*, or carnation yellow, which has a reddish rosy tinge (sometimes artificially

given by fire); *giallo paglia* (Fr. *jaune de paille*) or straw yellow, which is the colour of a canary, and is very rare; *giallo capo*, which is the colour of an orange; *giallo dorato* (Fr. *jaune doré antique*), which is the colour of the yolk of an egg; and, besides these, a yellow-purplish marble: all of these must be free from spots and veins, but there is a variety with rings of deep or almost blackish yellow, called in Florence *giallo brecciato* (Fr. *jaune annulaire* or *brèche jaune antique*), which may be suspected to be obtained from the same quarries that supply giallo di Siena: indeed BRARD, *Minéralogie*, 8vo., Paris, 1821, ii, 290, 296, seems to apply the term giallo antico to the *breccia dorata*, which is a collection of red and white spaces between masses of the yellow ground. YELLOW MARBLE.

GIAMBERTI (GIULIANO), called SAN GALLO, born at Florence 1443, was a son of Francesco (architect to Cosmo de' Medici), and was a pupil of the carver Francione. He commenced his career as a military engineer at the siege of Civita Castellana; he designed one side of the cloister as it now exists in front of the monastery called Cestello afterwards Sta. Maddalena de' Pazzi at Florence, and a palace at Poggio a Cajano (the front is given in SEROUX D'AGINCOURT, *Hist.*, fol., London, 1827, Architecture, pl. 72), for Lorenzo de' Medici who rewarded him by an annual stipend. In the latter, which was immediately commenced, he adapted Bramante's system of framing floors to the coved flat ceiling, *arco a botte*, of the great hall (163 ft. long, 68 ft. wide, and 65 ft. high), forming the widest ceiling then known: VASARI notices that Giuliano was erecting a house for himself in the Borgo Pinti at Florence, and made its hall a model for the work; this mansion afterwards became the palazzo Ximenes, now Panciatichi, was finished by G. Silvani, and is given in GRANDJEAN and FAMIN, *Arch. Toscane*, fol., Paris, 1846, pl. 77-8.

Among the drawings by Giuliano now in the Barberini library, is the plan of a palace, dated 1488, which was sent (according to GAYE, *Carteggio*, 8vo., Florence, 1840, i, 301) by Lorenzo to Ferdinand I. of Naples; the duke of Calabria requested that Giuliano might prepare a model for a palace; and the bishop della Rovere (afterwards pope Julius II), being castellan of Ostia, employed him for two years in improving the fortress there. The model having been completed by his brother Antonio, Giuliano was permitted to take it to Naples, where the work was at once commenced near the Castel Nuovo. He began 1488 for Lorenzo an Augustinian monastery at a short distance outside the porta di S. Gallo at Florence; before 1486, however, he was called "da San Gallo", by which surname his brother and nephews were subsequently known.

In 1490 the prince, excusing himself to the duke of Calabria for not lending him an architect to succeed G. da Majano, asserts in his letter (GAYE, i, 301) that he is even obliged to invite L. Fancelli from Mantua, and avoids all mention of Giuliano, who nevertheless proceeded, if not with all the other fabrics commenced by Lorenzo, at least with the monastery which (left incomplete at the prince's death 1492) was destroyed in the siege 1530 of Florence; and with the fortifications and buildings of the Poggio Imperiale; which last work, as it advanced, was so much admired that Lorenzo was requested to allow him to prepare the model for a ducal palace at Milan, and the building was commenced but not completed in consequence of the conquest of that city by the French. A palazzo for a Venetian, near the porta di Pinti at Camerata; with numerous private houses, and the palazzo Gondi "in the Tuscan manner" (in the piazza di S. Firenze) begun 1494 (but 1490, according to GRANDJEAN and FAMIN, pl. 50-5) at Florence, are further mentioned as having been designed by Giamberti, by VASARI who states that the death of the owner put a stop to the latter work, for which a chimneypiece (given in CICOGNARA, *Storia*, ii, pl. 15) was executed by Giuliano, who was assisted by his brother in these private works. FANTOZZI, *Guida di Firenze*, 8vo., 1842, p. 528, acknowledging that the palazzo Antinori has been ascribed to Baccio d'Agnolo, thinks it the

work of Giuliano on account of the similarity of the cornices and rustics to those of the palazzo Gondi. During the years 1485-9 he was engaged on the construction of the church of the Madonna delle Carceri at Prato. The brothers then settled at Rome, where Giuliano added a façade of three orders of pilasters to the Florentine church (in a Pointed style) dell' Anima; and was employed to restore the roof and to make the ceiling of the church of Sta. Maria Maggiore. He transferred the latter work to Antonio, being engaged by the bishop della Rovere, then cardinal of S. Pietro in Vincoli, to prepare a model for the palace which he proceeded to construct next to the north side of the church that is so called. He then sent by Antonio a model for the palace which was proposed at Savona by the same prelate, who caused Antonio to put the work into execution; this was proceeding rapidly when Giuliano revisited Rome with the cardinal, who eventually sent him to Lyons with the model of a palace as a present to Louis XII, who liberally rewarded and sent him back to finish the edifice at Savona; it was afterwards converted into the nunnery of Sta. Chiara. He paid, after a detention of six months at Pisa, a ransom of 300 ducats incurred by being taken prisoner in Feb. 1497 during his journey from Savona to Florence, having settled 1496 with his brother in their native city, where they described themselves in the census 1498 as *legnaiuoli* or joiners (GAYE, i, 338-9, 343). Giuliano roofed the church of the Madonna at Loreto, and completed 13 May 1500 its cupola commenced by G. da Majano, besides being employed at S. Miniato, Borgo S. Sepolcro, and Arezzo (GAYE, ii, 49-57) till 1503, in which year he left for Rome, taking with him J. Sansovino, on the accession of Julius II, who appointed him superintendent of the buildings undertaken by that pontiff before the arrival of Bramante, who not only endorsed Giuliano's recommendation that Buonarroti's monument for the pope deserved a special building, and the general impression in favour of making the building be a new S. Peter's, but obtained the commission for that work. This so enraged Giuliano that, although associated with Bramante in other works to be executed at Rome, he returned to Florence 1504 for six months. The pope again secured his services for the completion of the fortification of the Belvedere, the Borgo, the great round tower commenced by Nicholas V, and other works at Rome; took him 1507 to Bologna, where Giuliano suggested the statue by Buonarroti; to Miranda; and back to Rome, where Giuliano recommended the employment of Buonarroti at the Sistine chapel, estimating the value of his work at fifteen thousand ducats, and teaching him the means of obviating efflorescence on the fresco. Not being employed on any considerable work except, apparently, the church of the Madonna di Loreto at Rome, nor selected to execute the façade of the church of S. Lorenzo at Florence, he decided upon quitting the pope's service, returned 1507 to Florence, and was engaged by Soderini at the siege of Pisa; there he constructed, with Antonio, a bridge of boats that contributed to the capture 8 June 1509 of the city, and afterwards was engaged, excepting during a professional visit to Lucca in September 1509, in fortifying the town and erecting (of the Doric order) the porta di S. Marco (GAYE, ii, 111-22). He once more visited Rome because Leo X, on his accession 1513, remembered the old servant of the Medici, and appointed him 1 January 1514, in which month Bramante died, architect to S. Peter's, which post he held, receiving the usual salary of 300 gold ducats per annum, till 1 July 1515 according to FEA, *Notizia*, 8vo., Rome, 1822, p. 12; but worn by his many labours, oppressed by the weight of years, and suffering from internal disease, he resigned; once more returned to Florence; and dying there 1517, was interred in the family burial-place in the church of Sta. Maria Novella.

In the library of the university at Siena some drawings by this artist are preserved, which may probably be the book of studies of ancient buildings at Rome, mentioned by NAGLER, *Lexicon*, s. n.

GIAMBERTI (FRANCESCO), born 1498 at Rome, was a son of Giuliano; assisted his uncle Antonio in the care of the fortifications of Florence during the siege 1529; succeeded 1543 Baccio d'Agnolo as architect to the cathedral; and was one of the committee appointed 1568 to reform the accademia di S. Luca (of which he was a member) in that city, where he died before 1571. GAYE, ii, 165, 174, and 350, notices his employment at Prato and Pistoia 1528, and at Florence 1546. 73.

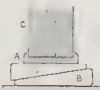
GIAMBERTI (ANTONIO), born 1448, was educated as a carver. Besides the assistance he gave to his brother Giuliano, as mentioned above, he superintended 1492-5 the alteration of the tomb of Hadrian into the castello S. Angelo; and designed the fortification of it, as well as of Civita Castellana, and other places for the pope and his son Cesar Borgia, duke of Valentinois, including the fortress of Montefiascone (attributed to Giuliano by MILITIA), of which in 1759 only some fragments of the walls were visible. In 1496 he rejoined his brother at Florence, as above noticed, and was engaged till 1498 on the works at the sala nuova and the chapel of the palazzo della Signoria, according to GAYE, i, 585-8, who ii, 61-134, indicates his occupation 1504-13 in fortifying the Florentine possessions; and 160-73 notices him as being employed at Montepulciano 1525, and at Castrocaro 1527. In 1515 he erected on the piazza de' Signori a temporary octagonal temple in honour of the pope's visit to Florence. After 1517 he is supposed to have designed the fortress at Perugia and at Leghorn, but the latter work was much altered. The church of the Madonna outside the porta di S. Biagio at Montefiascone, in plan a Greek cross with a cupola and two campanili (one incomplete), was designed, and superintended by him during half-yearly visits, and he also built in the piazza of that town the Canonica with a double loggia; and opposite to the cathedral a palazzo for the cardinal di Sta. Prassede; for whom he erected the palazzo, now the government offices, in the fortress of Monte Sansovino. Among other works were a loggia opposite the building last named; and a range of houses in the style of the loggia degli Innocenti, for the Servite monks, on the piazza of their monastery at Florence; where also, with S. Pollaiuolo and Baccio d'Agnolo respectively, he moved the statue of David by Buonarroti and the group of Hercules and Cacus by Bandinelli to their pedestals; he also prepared models for the ailes of the church of the Madonna delle Lagrime at Arezzo; and for the church (not executed) of the Madonna del Calcinajo at Cortona. He died 1534, and was interred in the family burial-place in the church of Sta. Maria Novella at Florence.

He had five nephews who practised as architects; viz. Francesco GIAMBERTI, above noticed; Antonio, with Battista PICCONI; and Giovanni Francesco, with Sebastiano, da SANGALLO; the two last are sometimes erroneously called the children of Giuliano, GAYE, ii, 160. 73.

GIANNOZZI, see GIOVANNOZZI (PIETRO).

GIARDINI, sometimes written GIRARDINI (....), designed the palais de Bourbon at Paris; it was begun 1722 by Cailleteau Lassurage, continued 1724 by Gabriel, and enlarged for the prince de Condé to whom it was belonging in 1750; it is now the chambre des Deputés. BLONDEL, *Cours*, vi, 489; and *Arch. Franç.*, i, 265.

GIB. The name given to each metal cheek, A, that serves to clasp together two or more pieces of wood or metal, c, placed side by side, when the space between the heads of the pieces and the abutment is to be wedged up with keys, B.



GIBBET of a crane, see JIN.

GIBBON or GIBON (JOHN) is recorded as "marmorarius" to Edward III; "the strong and stately castle of Queenborough (built about 1361-7), which guarded the entrance of the Medway, was a monument of his skill; and the grant 1339) of an hereditary toll on the passage from Sandwich to

Stonar, in the isle of Thanet, is the reward of no vulgar artist"; LORD SHEFFIELD, *Auto. Memoir of Edward Gibbon*, 1796, edit. 8vo., London, 1837, 3; HASTED, *Kent*, fol., London, 1799, iv, 250.

GIBBS (JAMES), F.R.S. The memoirs of this architect are so scanty, that it is satisfactory to be enabled to refer to an hitherto unnoticed MS., formerly belonging to Henry Holland, but now in Sir John Soane's museum, entitled "*A few short remarks on some of the finest antient and modern Buildings in Rome, and other parts of Italy, by Mr. Gibbs, while he was studying Architecture there, being memorandums for his own use—1707—and not intended to be made public being imperfect*"; followed by "*A short account of Mr. James Gibbs, Architect, and of several things he built in England, etc., after his return from Italy*". Many of its details betoken an intimate acquaintance with his early life, and with the order, and execution of the works, and certain particulars connected with them. It has been followed, therefore, in preference to the memoir in the SCOTS MAGAZINE, 1760, xxii, 475, with extracts from his WILL; CUNNINGHAM, *Lives*, etc., 12mo., London, 1831, iv, with a portrait; WALPOLE, *Anecdotes*, Wornum's edit., 8vo., London, 1849, 691; BUILDING CHRONICLE JOURNAL, 4to., Edinb., 1854, i, 22, 30, with a fac-simile signature; and BUILDER JOURNAL, 1858, xvi, 655, 710. Dates and other particulars within brackets have been added in the present notice.

Gibbs was born 26 December 1682 at a place belonging to his ancestors called Fittysmire (now Footdeesmire) at Aberdeen. William, an elder brother, succeeded to the property: James "having a great genius for drawing, and being of a rambling disposition", went on a visit to an aunt in Holland; afterwards travelled through Flanders to Paris, and then through Switzerland and Germany into Italy, where he remained several years. The architecture of Rome having incited him to become an architect, he obtained recommendations to C. Fontana, in whose school he studied, during some years, architecture, geometry, and perspective. The British nobility there employed him to make drawings, and were of service to him when, returning 1709 to England on account of the illness of his brother, he settled in London, and was patronised by the earl of Mar, the duke of Argyle, and many others, including Sir C. Wren. After the passing of the Act of Parliament in 1711 for building fifty new churches, the Commissioners ordered their surveyors to make designs for a church in the Strand; the one by Gibbs being considered the most appropriate, a model was ordered, and the first stone was laid with the usual ceremonies. The church was to have had a bell turret, while at the distance of 80 ft. from the west front was to have been erected a column about 12 ft. in diameter and 200 ft. high, upon a pedestal, with a figure of queen Anne in brass gilt; this was commenced and partly paid for, but on her death the whole work was suspended, and eventually instead of the turret a steeple was built, the shape on plan being caused by the completed substructure. (This church of S. Mary-le-Strand, or the New church, was built 1714-7, and consecrated 1 January 1724; it is 70 ft. long, 30 ft. wide, and 46 ft. high, internally.) His next public work was the completion (1719) of the steeple of S. Clement Danes, Temple Bar. He designed a house at Petersham (or Sudbrooke as stated in his *Book*) near Richmond, Surrey, for John duke of Argyle; Canons, Middlesex, for James duke of Chandos, with the chapel (this magnificent house which cost about £250,000 and was pulled down 1747, is generally attributed to J. James of Greenwich); a greenhouse and offices for the earl of Islay at Whitton (Middlesex); 1720 the octagon room for secretary Johnston (now Orleans house), additions and repairs to Pope's villa, a large room for Sir Challoner Ogle, all at Twickenham; he "modelled" the house there for Mr. Backwell the banker; made additions to Mr. Gunley's and Sir John Chester's houses at Isleworth; repairs and additions to governor Phillips's seat at Stanwell, and to lord Weymouth's house at Old Windsor with other works for him;

he designed other buildings in that neighbourhood; a seat at Isleworth for the earl of Shrewsbury, besides the interior of his house in Oxford-street; "modelled" Dawley for lord Bolingbroke, with large additions, which was sold on his visit to France; built a hunting box at Byfleet, Surrey, for General Cromwell; repaired the seat at Roehampton, Surrey, for Messrs. Clark and Young; designed many temples and ornamental buildings for the duke of Bolton at Hackwood, and a house for him at Cannam Heath, near the former place, with other works not executed; houses for Charles Leigh, Esq., at Leighton, Bedfordshire; for Mr. Hanbury near Northampton; and for Mr. Cotton at East Barnet; with the library, etc., for Dr. Mead in London (at No. 49 Gt. Ormond-street, Bloomsbury, after 1714). He made a design for rebuilding Arundel castle, Sussex, for the duke of Norfolk, which was put aside for works at Workshop manor in Nottinghamshire; made many drawings for Sir Robert Throckmorton at Weston in Bedfordshire (? Weston in Buckinghamshire), "which his son proposes to build"; designed a house near Stowmarket, Essex, for Mr. Jennings; made many drawings for lord Fitzwilliam's house near Peterborough (shown in his *Book*), "not carried out from his lordship's death"; and effected repairs at Ragly castle, Warwickshire, for the earl of Hertford: "the earl of Burlington had him to build and adorn his house and offices in Piccadilly, they are all built with solid Portland stone, as is likewise the fine circular colonnade fronting the house, of the Dorick order." For the earl of Oxford he built the chapel near Cavendish-square (S. Peter's, Vere-street, 1721-4, at a cost of £7,000, a copy of the specification is in the British Museum, Add. MSS. 18,238, p. 37, etc.), and the library and chapel at Wimpole, Cambridgeshire; he designed several ornamental buildings in Tring park, Hertfordshire, for Mr. Gore; others for Sir Thomas Lee near Aylesbury; and others, with a large room and other buildings at Gubbons in Hertfordshire, for Mr. Sambrook.

His later public works were, S. Martin's church, Charing Cross (1722-6, carried out at a cost of £33,017:9:3, of which he received about £600; it is 115 ft. long, with 15 ft. more for the vestibule, 70 ft. wide, and 42 ft. high internally; the tower and spire is 185 ft. high; the hexastyle Corinthian portico, advanced two intercolumniations, is 24 ft. deep and 63 ft. wide): the senate house or "Comencement room" at Cambridge (1722-30, it is usually said to have been a design by Sir J. Burroughs), this part alone of the whole design was finished, the library and other buildings being only carried up ground-high for want of money: and the Fellows' buildings (1724, at a cost of £20,000), on the west side of the court of King's college, Cambridge, with designs for the other two sides. He executed Fairlawn church, Kent, for lord Barnard, and his monument therein, with additions to the house; Ditchley in Oxfordshire, for the earl of Lichfield (about 1720, where there is a model of the Radcliffe library; NEALE, *Seats*, 1822, ser. 1, iii), and designs for temples, triumphal arches, etc., for the park; the body of Allhallows (or All Saints) church, Derby (1725); Patts hall, Shropshire, for Sir John Astley, and the church adjoining; a house (Bank hall) for Thomas Pattin, Esq., near Warrington in Lancashire; another for the Hon. John Barry Smith, at Aston park, Cheshire; that for the duchess-dowager of Norfolk in Arlington-street, with additions to her villa at Chiswick; and that for Sir Philip Parker Long in Leicester fields. He "laid the foundation 1739, and carried up the walls a considerable height, of a larger house for lord Craven at Hampstead Marshall, Berkshire, his death putting a stop to the works." He designed many ornamental buildings at Stow for Lord Cobham, with additions to the house; and, giving "his drawings, time and attendance gratis to this hospital out of charity to ye poor", the buildings for Bartholomew hospital, Smithfield, commenced 1730 forming a quadrangle 200 ft. long by 150 ft. wide (the Smithfield gate, which is earlier, is said not to be by him), executed in Bath stone (being the earliest instance of its use in

London; the buildings were recased in 1851 by P. Hardwick, R.A.) The last work mentioned in the MS. is the Radcliffe library, Oxford (1737-47, a rotunda of 100 ft. in diameter externally completed by a dome, and 140 ft. high to the top of the lantern, at a cost of £40,000; on its completion he had the degree of M.A. conferred upon him).

The following works are attributed by various authors to Gibbs: about 1721 Shipborn church, Kent, for Sir Henry Fane; 1724 Oxford market, Castle-street, Oxford-street; 1732 additions to S. Thomas's hospital, Southwark; 1732 the original or centre buildings of Gordon's hospital at Aberdeen; where 1752-4 his last work was the rebuilding of the West church, or S. Nicholas as it was then called; and 1741 Marylebone church in High-street, London, now the chapel of ease, for the enlargement of which he left £100. Balveny house, Banff, for the Hon. William Duff of Bracco, is ascribed to him by ADAM, *Vit. Scot.*, fol., Edinb., 1720-40, pl. 90-1. The new quadrangle at All Souls college is by Hawksmoor; and S. George's church, Hanover-square, is by James, though both have been attributed to Gibbs.

The MS. also mentions the following tombs in Westminster Abbey: marchioness of Anandale, ob. 1716; John Smith, Esq., ob. 1718; duke of Newcastle, ob. 1711, erected 1723; Matthew Prior, ob. 1721, who ordered it shortly before his death, to cost £500; Ben Jonson, ob. 1637; Dryden, ob. 1700; Dr. Freind, ob. 1728; and Mrs. Bovey, ob. 1724; with Mr. Stewart's, ob. 1714, in S. Margaret's church; and others.

He is said to have visited Spa in 1749 for his health; he "died 5 August 1754, aged 71", according to the tablet near his vault in Marylebone chapel above mentioned. His Will disposed of an estate of about £15,000; having no relations, he left his library of about 500 volumes, of which nearly 100 are the best architectural works of that period, drawings in six volumes and in portfolios, to the trustees of the Radcliffe library; £400 to John Borlach, "many years my draughtsman"; a noble bequest to the only son of the earl of Mar, his early benefactor, then in distress; legacies to public charities, etc. His publications consist of *A Book of Architecture*, fol., London, 1728, from the sale of which he derived much profit as well as reputation; it contains very many of the above designs, with various others for architectural decorations and ornaments; *Rules for Drawing the Several Parts of Architecture*, fol., London, 1732; and *Bibliotheca Radcliviana*, imp. 4to., London, 1747, which gives the names of the master tradesmen employed, and a portrait of Gibbs after Hogarth. The two first publications exercised great influence upon the architecture of the period, in London as well as in the country, and this fact is noted in the MS. The examination of the drawings of Gibbs affords a most instructive lesson, as shewing the progressive development of ideas in the conception of a design. He appears to have held the office of surveyor to the commissioners for the fifty new churches, as above mentioned, but 6 January 1716 J. James and N. Hawksmoor were chosen surveyors in his room; HISTORICAL REGISTER, s. d.

A bust of Gibbs in marble by Rysbrack was given by himself to the Radcliffe library, of which the trustees presented 1862 a cast to the Royal Inst. of Brit. Architects, which also possesses a list of Gibbs' professional books and drawings; another bust is mentioned as existing about 1790 on the staircase of the mansion at Brockley hill near Edgware, formerly belonging to — Sharpe, Esq., secretary to the duke of Chandos. The picture gallery of the Bodleian library contains a half-length portrait by Williams; and another, kit-cat size, shewing a plan of Radcliffe library, is at S. Mary's hall at Oxford, both having been presented by Gibbs. Besides the engraved likeness above mentioned, there is one after Huyssing in WALPOLE, *Anecdotes*, 1849 edit.; and another exists by Schryder.

GIBEL BARKAL or DJEBEL EL BARKAL, in Egypt, see MOUNT BARKAL.

GIBLET CHECK, or **GIBLEA CHEQUE**. A term used by masons in the south-west of Scotland for a check or rebate in jamb stones to receive a door that opens outwards, as coach-house doors, so as to make the outer side of the door flush with the face of the wall.



W. R. C. 1. 2.

GIBALTAR STONE, see **ALABASTER**.

GIBSON (JESSE) of Hackney in Middlesex, rebuilt 1788-92 the church of S. Peter-le-Poor, Old Broad-street, London, at a cost of upwards of £4,000, the interior forms a rotunda of 55 ft. diameter (BRITTON and PUGIN, *Public Buildings*, 8vo., 1828, ii, 72); and about 1790 designed a villa for J. A. Rucker, Esq., near Lord Spencer's park at Wandsworth, on an elevated position (LYSONS, *Environs*, 4to., 1792, i, 518). He was appointed surveyor to the Worshipful Company of the Drapers 1797 (was elected a member of the court on his resignation 1822); also to the Saddlers' Company 1774 (whose hall in Cheapside he rebuilt 1822); was employed for the Vintners' Company 1800-20; and was district surveyor of the eastern division of the city of London. He died 24 June 1828 in the eighty-first year of his age, and was buried at Wimbledon, Surrey, where two sons, John and Robert, are also buried. His portrait exists at the Drapers' hall, Throgmorton-street.

GIERDEGOM (JOSEPH FRANÇOIS VAN), born 12 October 1760 at Bruges, became professor in the royal academy at that city, and built, besides a country house at Berchem, another at Merkem, and several houses in Bruges and its neighbourhood; a château for the baron de Peelaert 1813 at S. André, about two miles from that city on the road to Ostend, given in GOETGHEBUER, *Choix des Monumens*, fol., Ghent, 1827, pl. 11-13, in which he is called Geerdgom the elder; but IMMERZEEL gives the name Gierdegom as in GOETGHEBUER's list of subscribers. The chapel containing the celebrated ducal tombs in the church of Notre Dame at Bruges was rebuilt 1816 by this artist, who is called van Ghierdegom in WEALE, *Handbook*, 8vo., London, 1859, p. 145.

GIG STICK. A term used in Norfolk for the radius, rod, or trammel to which the mold is fixed in running plaster moldings to arches, etc.

A. W. M.

GILABERT (DON ANTONIO), born 9 April 1716 at Pedreguer in Valencia, acted as aparejador for his brother-in-law F. Rubio in the erection of the custom house, and finished the elliptic church of the hospital de los Esculapios in that city. His display of practical knowledge gained great approbation in the archway and staircases of the former, and the roof of the latter of these works, as well as in his reconstruction of the last pillar on the north side of the nave of the cathedral. He repaired the cathedral, changing it from a Pointed to an Italian work; and designed the celebrated chapel of S. Vicente Ferrer and the cell of S. Luis Beltran in the monastery and church of S. Domingo, all in Valencia, where he became 17 February 1768 director and professor, and 31 December 1784 director-general, of the royal academy of S. Carlos; and died 13 December 1792. He also designed the parish churches at Toris and at Chate-Algar, with the mansion of the conde de Villapaterna, and the hermitage of the Virgin at Nules, near Valencia. 66.

GILARDI (GIOVANNI BATTISTA), born 1757 at Barca in the canton Tessin, settled at S. Petersburg, where he built the Sta. Catherina institution; the hospital for the poor; the great exchange, etc. 68.

GILARDI (Cavaliere DOMENICO), son of the above, was born at Montagnola, studied at Milan, and went to Russia, where he erected many large buildings, and was entrusted 1812 with the superintendence of the rebuilding of Moscow. 68.

GILBERT (SAINT), see **MORAY** (GILBERT OF).

GILBERTINE BUILDINGS. It is usually said that there was only one of these establishments in England, i. e. that built 1415 at Sion opposite Richmond; but the *Britannia Sancta*, 4to., London, 1745, ii, 177, mentions Barking monastery, which, "like divers others in the primitive English

church, contained a double community, the one of men, the other of women, living in separate habitations under the rule and government of an abbeſs." It appears that, at the dissolution of the monasteries, there were in England and Wales about twenty-five houses of this order, which was founded about 1131 by S. Gilbert of Sempringham; the nuns called Bridgetines observed the rule of S. Benedict, while the monks followed that of S. Augustine, and were considered as canons. Besides four monasteries solely for men, the founder himself established nine such double monasteries, each of which should rather be described as a contiguous monastery and nunnery, separated by a party wall and by a church, where the lower part was used by the prior and his twelve monks, while the upper portion was occupied by the sixty nuns and their abbeſs, who had the chief management of the establishment. BUONANNI, *Ordini*, ii, 20; WEEVER, *Funeral Monuments*, fol., London, 1631, p. 148; DUGDALE, *Mon.*, fol., Lond., 1830, vi, 946. 13.

GIL DE HONTAÑON, now written Ontañon (JUAN), born at Rasines, a town about fifteen miles from Santander, was one of the nine architects who composed the celebrated committee which assembled 3 September 1512 at Salamanca to examine the plans and preparations made 1508 by A. Rodriguez and A. de Egas for the new cathedral in that city. He was nominated 6 September 1512 the *maestro principal* of the work with an annual salary of forty thousand maravedis, and a payment of 100 more (one guinea) for each day's work, with leave of absence for six months in each year until his buildings at other places were completed. The structure was commenced 12 May 1513, he made drawings 1522 for an additional chapel, and it appears from a document dated 14 December 1520 that Gil was the contractor for a considerable portion of the building; while the records show that works to it jointly designed 1524 by A. de Covarrubias, J. de Alava, F. de Vigaray, and H. de Egas, were being executed 1531 by J. Sanchez de Alvarado under the direction of Gil. He was employed 1513 to report with J. de Badajoz and J. de Alava on the fall of the dome of the cathedral at Seville, and was retained as *maestro mayor* 14 September of that year to rebuild it with the needful variations from its first design: this work was finished as to the dome 1517, and as to the rest (apparently inclusive of the capilla real designed by Alava and Egas) 4 November 1519. Having previously made the drawings, he commenced 8 June 1522 as *maestro mayor* the cathedral at Segovia, where, in consequence of illness and absence, he was superseded 1525 by G. de Cubillas: the archives show that Gil's design, attacked 1529 by J. de Alava with the assent of A. de Covarrubias, was defended by H. de Egas and F. de Vigaray. Dying between June and September 1531, he was succeeded at Salamanca by J. de Alava. 66.

GIL DE HONTAÑON (JUAN), a son of the subject of the preceding article, acted as assistant to his father 1521-2 in the works of the cathedral at Salamanca, after which period his name does not occur. 66.

GIL DE HONTAÑON (RODRIGO), brother of the subject of the last article, designed 1520 the colegio mayor of the Order of Santiago el Zebedeo called the colegio del arzobispo at Salamanca. He was invited 1535 from Torrelaguna to survey the works of the larger sacristy in the cathedral at Seville, and was made 10 May 1538 *maestro mayor* of that edifice as successor to J. de Alava. He designed 1541 the front of the colegio mayor executed by P. de Cotera at Alcala de Henares (this work is not in a Pointed style); about 1545 the churches of Sta. Euphemia at Beceril and of S. Esteban (of the Ionic order) at Castro-mocho; about 1565 the college of the Order of Santiago called the colegio del rey in Salamanca, to which he was appointed 6 April 1566 *maestro mayor* with an annual salary of fifty thousand maravedis; and after laying 5 August 1563 the first stone of the capilla mayor in the cathedral at Segovia (the last cathedral built in a Pointed style in Spain), he succeeded 1568 to G. de Cubillas as *maestro mayor* to that edifice, holding all

these appointments until his death. He designed 1575 the church, and 1576 the capilla mayor of the church of Sta. Maria Magdalena at Valladolid; and, dying 31 May 1577, was buried in the cloister of the cathedral at Segovia. His will, which is given in *LAGUNO*, i, 315-25, mentions as designed and executed under contract by him the churches at Fontiveros, Nava del Rey (neo-classic), S. Julian at Toro, Villaumbrales, and Sta. Maria de la Mata, with chapels in the parish churches at Villavieja, Tamames, and Villama de los Escuderos, all of which seem to be in the neighbourhood of Valladolid. 66.

GILDING. The art of ornamenting certain portions of a building with gold beaten into thin leaves. It is of very great antiquity, being mentioned in *EXODUS*, xxv, 11, 12, and in *HERODOTUS*, ii, 129, 132, 182. Its use by the ancient Egyptians is noted by *WILKINSON*, *Manners*, etc., 8vo., London, 1837, iii, 234-6. *PLINY*, *H. N.*, vii, 56, attributes the invention to Cadmus, and says, xxxiii, 18, that the first introduction of gilding at Rome was at the Capitol, after the censorship of L. Mummius, B.C. 142; after which period the use of it spread rapidly to all sorts of dwellings, public and private. He also describes gold leaf, which he calls 'bractes', and says the thickest sorts were called 'præneste', and the thinnest 'quæstorie bractes'. These, however, were much thicker than the present English leaves, as only 750 bractes, of 4 digits square each, were made out of the ounce; while modern use obtains 2,000 leaves, each $\frac{3}{8}$ square (very nearly the same size), out of only fourteen pennyweights of gold. On weighing a cubic inch of gold, and comparing it with the beaten leaf, it has been calculated that the latter is less than the three hundred and sixty-fifth thousandth of an inch in thickness, or less than one thousand times thinner than the paper on which this is printed. Gold leaf is generally alloyed with copper or silver, according to the colour required. This is also done to save expense; but when used in the open air, or where exposed to smoke or the action of gas, the gold should be pure.

Gilding is of two kinds; burnished, and 'mat' or 'dead' gilding. The former, being seldom used in architectural decoration, need not be described. The latter is done either in oil-size or water-size; the oil-size on woodwork, and the latter on plastering. Oil gold-size is a mixture of boiled linseed oil and yellow ochre. A coarser sort is mixed with red chalk and pipeclay, and with suet or some common fat instead of oil, and, it is said, with bullock's blood. Water-size is simply the purest size that can be got, also coloured with ochre: both are generally used warm, and applied by an ordinary camel-hair brush, as many coats being given as will stop 'suction' and bear out. The gold is applied just before the size is dry, but when dry it is sometimes damped with the breath of the workman. In moldings and small work which is readily got at, the gold leaf is spread on a cushion stuffed with flannel and covered with leather, and is cut to widths with a long and very thin-bladed ivory knife; it is then taken up by a sort of camel-hair brush called a 'tip' (some prefer a small piece of cotton wool), and applied to the moist size, to which it adheres, and is carefully pressed down so as to make it smooth, and free from wrinkles which the gilders call 'spider's legs'. For ceilings and other large work the gold leaf is applied directly from the book itself, the paper leaves of which are bent back or torn off one by one, as may be most convenient. **GOLD LEAF.** Gold for architectural decoration should not be too thin, nor should it have too much alloy, if any. The ceiling of the church of Sta. Maria Maggiore at Rome is said to have been gilded cir. 1507 with pure gold of double the usual thickness, the first that was brought from America; it is in perfect condition and likely to last for many centuries.

Gilding in architecture should be sparingly used so as rather to heighten the effect of ornaments than to cover them. If too copiously employed it looks both gaudy and heavy. The ceiling of the church of the Annunziata at Genoa is so covered that it has been compared to a gold snuff-box, and has any-

thing but a pleasing effect. Gilding on metal is employed in architecture for weather-cocks and similar terminations to spires and domes, and sometimes for gallery railings, as at S. Paul's cathedral, and sometimes on the ribs and ornaments of cupolas, as at the chapel of the Invalides at Paris, where the gilding of the dome has, however, now lost all its brightness, and the blue colour it used to have is now imperceptible. The metal is generally painted so as to prevent oxidation, and the gilding then executed in oil-size. For smaller articles it is doubtful whether the best and cheapest way would not be to make use of the electrotype process. Copper and lead take the gold readily, but there is greater difficulty with iron. Part of the metal roof of the clock tower at Westminster was coated with a preparation (of gutta percha or of Szeclmeyer's paint) before gilding; **GALVANIC ACTION**; the work at present stands very well; time, however, will alone show whether the process be durable for any considerable period. The ironwork of the great tower was well painted, and the gold applied absolutely pure and of extra thickness. One of the largest gilding works of late years was the reading room of the British Museum, where the gilding was done with double gold-leaf, and the gold was intended to be without alloy. **GOLD; GOLD PAINT.** A.A.

The gold ground for decorations as in mosaic work, and for illuminated manuscripts, is traced from the era of Justinian, cir. 532; the latter is noticed in *THEOPHILUS*; *RASPE*, in *Elements of Oil Painting*; *MURATORI*, *Med. Antig.*; the specimens themselves prove to be gold of much greater thickness than now used.

GILLESPIE-GRAHAM (JAMES), F.R.S.E., and F.S.A. Scot., of Orchill, Perthshire, an estate he acquired by his marriage with the daughter of William Graham of Orchill, was born in Dumblane about the year 1777. He was located at Edinburgh, and practised for more than half a century, being extensively employed in various parts of the country upon designs in the mediæval style. About 1810 he designed Culdees castle, Perthshire, for general Drummond of Drummawhence; 1812 Ross priory, Dumbartonshire, for H. M. Buchanan, Esq.; probably about the same period Dunse castle, Berwickshire, for W. Hay, Esq., of Drummelzier (all given in *NEALE*, *Scots*, ser. 1, vi); and finished in 1813 Crawford priory, for Lady Mary Lindsay Crawford, Cults, Fifeshire: in Edinburgh he erected 1813-4 the Roman Catholic chapel in Broughton-street; 1815 laid out part of the lower new town; 1819-20 erected Dr. Jamieson's chapel; in Glasgow 1814 the Roman Catholic chapel of S. Andrew's, costing £13,000; and 1825 designed Hamilton-square, Birkenhead, near Liverpool, for Mr. W. Laird, which, though commenced soon after, remained for some years incomplete, but was finished on a reduced scale in 1845. *NEALE*, *Scots*, etc., 1824, ser. 2, i, gives views of Armidale, Isle of Skye, Invernesshire, for lord Macdonald; 1826, iii, of Blythswood, Renfrewshire, for A. Campbell, Esq., M.P.; 1828, iv, Lee place, Lanarkshire, for Sir C. M. Lockhart, Bart.; and Wishaw, Lanarkshire, for Lord Belhaven and Stenton. In 1836 his design submitted in the competition for the new Houses of Parliament attracted much attention; this, it is understood, was essentially the production of the late A. W. Pugin. In 1838 he designed Greenside church, the tower being added in 1853; about 1840 refitted the chapel of Heriot's hospital at Edinburgh; and 1842-4 carried out the Victoria or assembly hall in that city in conjunction with A. W. Pugin. Among his latest works were Murthly house, Perthshire, for Sir John Stuart; a chapel at the same place; additions and alterations on Taymouth castle, for the marquis of Breadalbane; Brodick castle in the Isle of Arran; and Aytoun house, Berwickshire, for W. Mitchell Innes, Esq. He died on the 21 March 1855, in his seventy-eighth year; and was buried in the Greyfriars' churchyard, Edinburgh.

GIMAL. This word apparently corresponded to *voussoir* in *LEONI's Palladio*, fol., London, 1742, ii, 46.

GIMLET or **GIMBLET.** This name is probably a corrup-

tion of whimblet, a small wimble, the old name for an AUGER, and said to be derived from the Anglo-Saxon *wembelen*, to perforate. A tool used by carpenters and joiners to bore holes to receive nails, etc. It is formed of a straight shank of steel, worked gradually into the form of a hollow half-cylinder with cutting edges, and terminating in an obtuse conical pointed screw. It is driven into the wood by turning it with a round cross wooden handle, into which the shank is rivetted. Gimlets are of various sizes, from about the twelfth of an inch to half an inch in diameter. Above that size an auger or shell-bit is usually preferred. Gimlets have lately been much improved by twisting the hollow cylinder into a spiral form, which makes a much cleaner cut, and enables the tool to be withdrawn more easily. Carpenters' gimlets vary from 4 to 10 ins. in length. Bell-hangers, however, have them 3 or 4 ft. long, for boring holes in walls to pass wires through. In Herefordshire this tool is called a 'nail-passers'. BIR. A. A.

GIMMER, see CHYMOL and GEMMEL.

GIN, see GYN.

GINNELL. A term used at Halifax in Yorkshire, as 'fox ginnell', for a passage between walls. W. R. C.

It is probably derived from the Scotch term 'vennel', a narrow passage or lane.

GINO built 980 the church of S. Salvador and Sta. Maria at S. Adrian y La Losilla near Vegaquemada in Leon, according to an inscription given in YEPES, *Cronica*, fol., Valladolid, 1609-21, iv, 357. 66.

GIOCONDO (FRA GIOVANNI) was called in Italy Fra Giocondo; and in France frère Jean Giocondo, Joconde, or Joyeux, a name apparently corrupted into Jean Doyac in the additions to MONSTRELET, *Chroniques*, fol., Paris, 1603, iv, 98: through some misapprehension VASARI's memoir of Giocondo, which included an account of a family called Bonsignori (printed in all editions Monsignori), later writers have assigned to a Giocondo Monsignori part of the career of Fra Giocondo, who was born at Verona about 1433-4, not 1453 as in VASARI, whose laudatory account is here put aside in favour of the authorities cited by the editors of his *Vite*, 12mo., Florence, 1853, ix, 155, and by MARCHESE, *Lives*, 8vo., Dublin, 1852, ii, 141. He spent great part of his life in literary and archaeological pursuits, especially in copying inscriptions; and joined the Franciscans before 1492-3, after having been tutor to Julius Cæsar Scaliger (born 1484). No memoir of him has included a notice of the discovery of "frère Jehan Jocondus, religieux de l'ordre de S. Francois, diviseur des bâtimens", at the head of the colony of Italians imported from Sicily into France by Louis XII (?), whose letters-patent dated 29 Jan. 1497 (?) giving him 46 livres 17s. 6d. per month, are mentioned by THOMASSY (who intimates that the king afterwards gave him 428l. 17s. 6d., which may be a misprint) in the COMITÉ HISTORIQUE DES ARTS, etc., *Bulletin*, 8vo., Paris, 1843, i, 168. The pont Notre Dame at Paris fell 1499, and, according to the *Chroniques* above named, "puis apres le roy y envoya Jean de Doyac pour donner la conduite de refaire" that bridge; the king seems to have been at that time at Milan or at Lyon. There are two versions of a distich by Sannazaro which has been supposed to have attributed to Giocondo the erection of two bridges, "geminos pontes", or "geminum pontem" over the Seine, and to have been engraved upon one of the arches of the pont Notre Dame; but it was not placed there according to SAUVAL, *Histoire*, fol., Paris, 1724, i, 218, 228-30, who mentions that many designs for a new bridge were made immediately after the accident, and submitted to the consideration of several experts from Blois and Auvergne. He adds that the first stone was laid 20 March 1500, and that (subsequently, unless SAUVAL is wilfully equivocal) Giocondo was present when the authorities discussed the necessity for a coffer-dam; and 20 July 1504, when they decided that the six arches should be lower than semicircles upon the advice of "frère Joconde commis au controlle de la pierre" and of

"Didier de Felin, maître des œuvres de maçonnerie de la ville et maître principal touchant la surintendance de l'ouvrage de la maçonnerie". SAUVAL hence infers that Felin was the designer of the bridge, but allows that he found Giocondo entitled "commis a soy donner garde sur la forme d'icelui pont", and receiving as wages 160 livres, equivalent to 30 to 40 pounds sterling of the present day according to then price of gold, but about £115 according to the wages then earned by masons. The epithets "professione architectus sed antiquarium diligentissimus", "architectus tunc regius", and "homo antiquarius architectus nobilis", are applied to Giocondo by BUDÆUS, *De Asse*, and *Annot. in Pandectis*, who conversed with him in Paris, where the temporary bridge of timber erected 1503 might have been the ground for the epithet 'geminum'. Giocondo quitted that city for Venice in 1506, in which year he surveyed the works then undertaken as an extension of the canale della Brenta, commenced 1488 and finished 1495, though VASARI describes the whole scheme as having been suggested by Giocondo, whose four reports are given in ZENDRINI, *Mem. Stor.*, 4to., Padua, 1811, ii, 247-74, and who was employed 1507 on some hydraulic works upon the Piave at Trevigi; and 11 August 1508 was at Venice, at which time probably the fondaco de' Tedeschi, burnt 1505, was built from his design according to CICOGNARA, *Fabbriche*, fol., Venice, 1838-50, i, p. 109-11, pl. 93-94, adopting MORELLI, *Notizia*, 8vo., Bassano, 1800, p. 241; but this building has been ascribed to Girolamo il Tedesco and to Pietro Lombardo. Giocondo was sent 9 June 1509 to fortify Trevigi (the documentary evidence is given in FEDERICI, *Memorie*, 4to., Venice, 1811, ii, 35-8, who also ascribes to him the design of the porta S. Tommaso), and then apparently quitted the Franciscan for the Dominican order.

He published, with the pretentious title "solito castigatore factus", an edition of the writings of *Vitruvius*, fol., Venice, 1511, which was reprinted with the addition of those by FRON-TINUS, 8vo., Florence, 1513 and 1522, and served as the basis of several later editions; although, according to his own confession, he took liberties with the received text, his edition was adopted by subsequent editors and translators until the time of SCHNEIDER, who again recurred to the manuscripts. In 1512 he was commissioned to supply a model for underpinning the ancient central pier of the ponte della Pietra or ponte Nuovo at Florence, that carried a roadway which continued to be of wood until 1520: his work was destroyed 1757 by a flood. As the ponte del Rialto at Venice was burnt 1513, Giocondo was requested to submit, with others, a design for its successor; he presented 5 March 1514 his scheme, described at great length by VASARI as including a project for a new piazza with a church; but the design by A. Scarpagnino was selected. In the same year, but apparently 1 Feb., he was appointed one of the architects to S. Peter's at Rome, where the foundations were underpinned, as VASARI explains, by G. da San Gallo and Raffaele under the advice of Giocondo, who received the usual salary of 300 ducats per annum, as discovered by FEA, *Notizia*, 8vo., Rome, 1822, p. 16, until 27 March 1518, at which time he probably died in that city, although some authors assign his death to the year 1530. His edition of CÆSAR, *Comment.*, fol., Venice, 1513, contained his views of the nature of that general's bridge over the Rhine, with some other diagrams.

In preparing this notice it has been found impossible to ascertain the authorities upon which several works at Verona have been ascribed to Giocondo: e.g. the repairs of two bridges, MILLIZIA, *Vite*, s.n.; a bridge 1468 of a single pointed arch 140 ft. span, DALLAWAY, *Anecdotes*, 8vo., London, 1800, p. 163; and the exterior of the church of Sta. Maria della Scala, *Handbook for Northern Italy*. The palazzo del Consiglio, and the portal of the episcopal palace, seem to have been ascribed to him, since MAFFEI, *Verona*, 4to., Verona, 1732, iii, 147, suggested that Giocondo or some equally clever artist must have been employed on them. The same impossibility

exists with regard to works in France: e.g. the cour des comptes at Paris, burnt 1737, BRICE, *Nouvelle Descr.*, 12mo., Paris, 1725, iv, 344; the château de Gaillon, where CALLET, *Notice*, 8vo., Paris, 1843, also mentions the assistance of a du Cerceau, whose name, like that of Giocondo, does not occur in DEVILLE, *Comptes de dépenses*, 4to., Paris, 1850; and the petit-pont in the continuation of the line of the pont Notre Dame at Paris, BRICE, iv, 368; its erection by Giocondo was contradicted in TEMANZA, *Vite*, 4to., Venice, 1778, p. 58.

GIOFFREDO or GIOFFREDO (MARIO GAETANO), born in Naples 14 May 1718, studied under M. Buonocore, and then from the works of Fansaga and D. Fontana in that city, and the writings of VITRUVIUS and PALLADIO. Soon after his twenty-third year he obtained in competition the commission for the church of S. Giacomo degli Spagnuoli at Rome (MILIZIA is wrong in stating that Fuga designed it). He obtained the ranks of cavaliere and conte Palatino; and, entering the Neapolitan service, was first employed on the government works in Calabria Ultra, where he was for some time engaged in superintending the working of the iron mines in the valle di Canneto. He then settled at Naples, where he rebuilt 1742-8 the sedile or seggio di Porto or di S. Giuseppe, as well as the nunnery of Sta. Caterina di Siena with its church and cloister; restored 1746 the palazzo Coscia, designing the present façade and its Ionic gateway; built 1762 the palazzo Cavalcanti in the strada di Toledo; and executed 1774 the cupola as well as the front of the church of S. Spirito. The palazzi Campolieto and Casacalenda, and the gateway of the nunnery of Sta. Maria Maddalena, are also attributed to Gioffredo, who planned the strade de' Pellegrini and di Monte Oliveto, and remodelled the palazzo Avalor in the piazza del Vasto. He published *Dell' Architettura di M. G.*, fol., Napoli, 1768; and was appointed 1783 chief government architect with a very liberal salary, but soon after became blind, and died 8 March 1785. A work entitled *De vita M. G. Neapolitani Architecti Commentariolum*, 4to., has not been seen. 3. 14. 95.

GIORGIO (FRANCESCO DI), see VANOCCHI (FRANCESCO).

GIOTTO, see BONDONE (AMBROGIO).

GIOVANELLI (BENEDETTO), born 1601 at Siena, constructed in that city the great cloister of the convent of Sta. Marta; 1663 the façade of the oratory of S. Giuseppe; and for pope Alexander VII the marble front of the Regio Ritiro del Rifugio, as well as the capella del voto 1661 in the cathedral. He died 1676. 112.

GIOVANNI, see BRACHETTI; CAMPI; FERNACH; PADUA; and PISA.

GIOVANNI (SIGISMONDO DI), a pupil of G. F. Mormando, erected 1507 the sedile or seggio di Nido with a cupola, which gained him the commission to execute the cupola of the Benedictine church of SS. Severino e Sossio, generally supposed to have been the first dome constructed at Naples, where he died 1540. 62. 95.

GIOVANNINOZZI, also called GIANNOZZI (PIETRO), was the designer of the alterations to the palazzo Del Sera, now Corsi, at Florence, and completed 1726 the palazzo Naldini commenced by P. F. Silvani.

GIOVARA, see JUVARA (FILIPPO).

GIOVENAZZO. A seaport in the province of Bari in Naples. The cathedral, dedicated to the Assumption and S. Giovanni Battista, was consecrated 1184 and 2 May 1283, and restored soon after 1671, when the church of S. Carlo of the Capuchins was commenced. The church of Sta. Maria fuori was built a little before 1657, at which period the monastery of the Minori Conventuali was commenced, and the episcopal palace was rebuilt; the monte della Carità was begun after 1693, and the church of S. Felice with the monastery of S. Giovanni Battista date about the same period.

GIPTON-WOOD STONE, see HAREHILL STONE.

GIRAL (....), who built at Toulouse the celebrated amphitheatre of S. Côme (i.e. the room for lectures upon

anatomy), was the father-in-law and teacher of Donnat, with whom he designed and executed the place Peyrou in that city; *Kunstblatt*, in *MORGENBLATT*, 1824, p. 256.

GIRANDOLE (DELLE), see BUONTALENTI (B. T.)

GIRANDOLE. This French word, equivalent to the English 'sconce', was extended before 1730 by French designers to a rich 'branch', i.e. a candlestick with several branches, to stand upon a table: and in England it was termed a 'lustre' when made of glass. 13.

GIRARD (....) is said to have been architect and intendant des bâtimens to Philippe duc d'Orleans, brother of Louis XIV; D'AVILER, *Cours*, 4to., Paris, 1760, who gives, p. 224, pl. 63a, a staircase by him in the hôtel de Vic in the rue S. Martin at Paris; and LABORDE, *Versailles*, 8vo., Paris, 1839, p. 68, mentions Girard and A. le Pautre as the architects 1660 employed at the château de S. Cloud by that prince: but BALTARD, *Paris*, fol., Paris, 1803, states the château was built for the Hervard family by Girard, and the wings by Le Pautre. VIRLOYS, *Dict.*, says that Girard designed the 'bassin des cignes' at the foot of the great staircase, and the front of the château towards the avenue. NAGLER, *Lexicon*, s. n., mentions his plan of Versailles engraved by Menant; and his view of Monte Pincio illuminated for the fête on the recovery of Louis XIV engraved by P. S. Bartoli, but confuses him with F. and N. Guerard as engraver of part of the plates for DESGODETZ, *Antiquités*, fol., Paris, 1682.

GIRARDIN (....) practised at Paris, where his chapelle and hospice de S. Nicolas, commonly called the chapelle Beaulon, numbered 59 in the rue du faubourg du Roule, ranked amongst the best productions of modern French architecture. These works, executed 1778-84, are given in LEGRAND and LANDON, *Descr.*, 8vo., Paris, 1808-9, i, 133, 210; iii, 79; and in KRAFFT, *Maisons*, pt. ii, *Choix*, 4to., Paris, 1838, pl. 80-83.

GIRARDINI, see GIARDINI (....).

GIRAUD (....), architect to the Louvre at Paris, succeeded Brébion 1790, and was succeeded by Hubert 1793; CLARAC, *Musée*, 8vo., Paris, 1841, i, 660.

GIRCHE, Girsche, Guirche, and Gerf Hossayn, in Nubia, see TUTZIS.

GIRDER (It. *trave*; Sp. *trabe*; Fr. *poutre*; Ger. *bindebalk*; Dut. *bindbalk*). A straight beam of any description of material capable of carrying a weight between two points of support. In the Teutonic languages, from which the word girder is derived, it seems especially to have meant a beam introduced for the purpose of girding or of tying together upright posts. The term is now commonly applied not only to the BINDING BEAM of a double floor, which supports the floor, but to any beam carrying an internal partition. Girders are generally let into walls and pinned to strong templates of wood or stone. If they have long bearings they are often supported by columns or story posts. In many of the old houses in London the girders are placed over the middle window of the room, and are then carried on a very strong lintel almost like a BRESSUMMER. Girders are generally placed 10 ft., 12 ft., and even 14 ft. apart; the binding joists from 4 to 6 ft.; and the bridging joists about one foot apart. BEAM; CROSS SOMER. Girders are further strengthened for long spans by cutting them longitudinally, reversing one of the pieces, and bolting them together; a system recommended by BLONDEL, *Cours d'Arch.*, 8vo., Paris, 1777, vi, 291; and still more so by inserting a fitch of wrought iron between the two pieces of timber, and bolting all three, as hereafter noticed. The use of varieties of girders or joists is noticed s. v. FLOOR, FIREPROOF. "The joists of warehouses were formerly carried on girders of whole timber, about 14 ins. square, laid from wall to wall and on caps on the top of posts; where a large knot happened to come near the bearings, the timber would sometimes split up: when the floors have been overloaded, the girders have sunk, the posts eating into them by the compression, and consequently when the weight was removed, the floors sprang up

again, and all the posts became loose, rendering it necessary for them to be wedged up. At the present day the plan adopted is to form the girder of two pieces of timber cut out of about 14 ins. by 9 or 10 ins., reversed and bolted together, the ends being laid on iron caps fitted on the top of the timber posts or iron stanchions, and instead of the posts standing on the girders, a dowel or pin is inserted between the two pieces forming the girder and between the head of the post below and the base of the post above, thus discharging the weight vertically through the posts, by which means the girders have only to carry the weight of each separate floor"; W. TITE, at Royal Inst. Brit. Architects, as given in *CIVIL ENGINEER Journal*, 1843, vi, 432.

Girders are either *simple* or *framed*. The *simple* girders are those formed of any material, in one homogeneous piece; those of wood or stone are generally used in the form of rectangular solid beams, whilst those of iron are used in the form of \mathbf{I} or \mathbf{H} beams with top and bottom flanges of variable thicknesses, proportioned to the weights to be carried; and in such cases in stone or wood, the power of the beams to resist a breaking weight equably distributed is proportionate to the width, multiplied by the square of the depth, and divided by the length of the bearing: the precise breaking weight being calculated by coefficients expressing the tenacity and resistance to compression of the material. Thus (without entering upon the philosophical discussion of the resistance of building materials, reserved to *STRENGTH OF MATERIALS*) the resistance of a rectangular beam to a permanent load is usually taken as being represented by the formula $w = \frac{b d^2 c}{l}$; in which w is sup-

posed to represent the breaking weight in cwt. : b , the breadth of the beam; d , its depth, both in inches; c , the coefficient of the material; and l , the length of bearing in feet. TREDGOLD, whose calculations are most commonly adopted in these matters, gives in the second section of his work on *Carpentry*, edition by BARLOW, 4to., London, 1840, art. 79 to 116, the application of this formula; and in the table at the end of HODGKINSON'S edition of TREDGOLD, *On the Strength of Cast Iron*, 8vo., London, 1846, will be found the data for fixing the dimensions of rectangular girders of the ordinary materials used in England. Cast iron girders are found to have the greatest amount of strength with the smallest amount of metal, when their transverse section is of the \mathbf{I} form; and from the researches of Mr. Hodgkinson it would appear that, theoretically, the area of the bottom flange should be six times as great as the area of the top flange; and the formula usually adopted for calculating their dimensions, when the thickness of the centre web is about $\frac{1}{4}$ or $\frac{1}{5}$ of the depth of the beam, is $2w = \frac{a d c}{l}$, in which the safe weight, w , is supposed to act

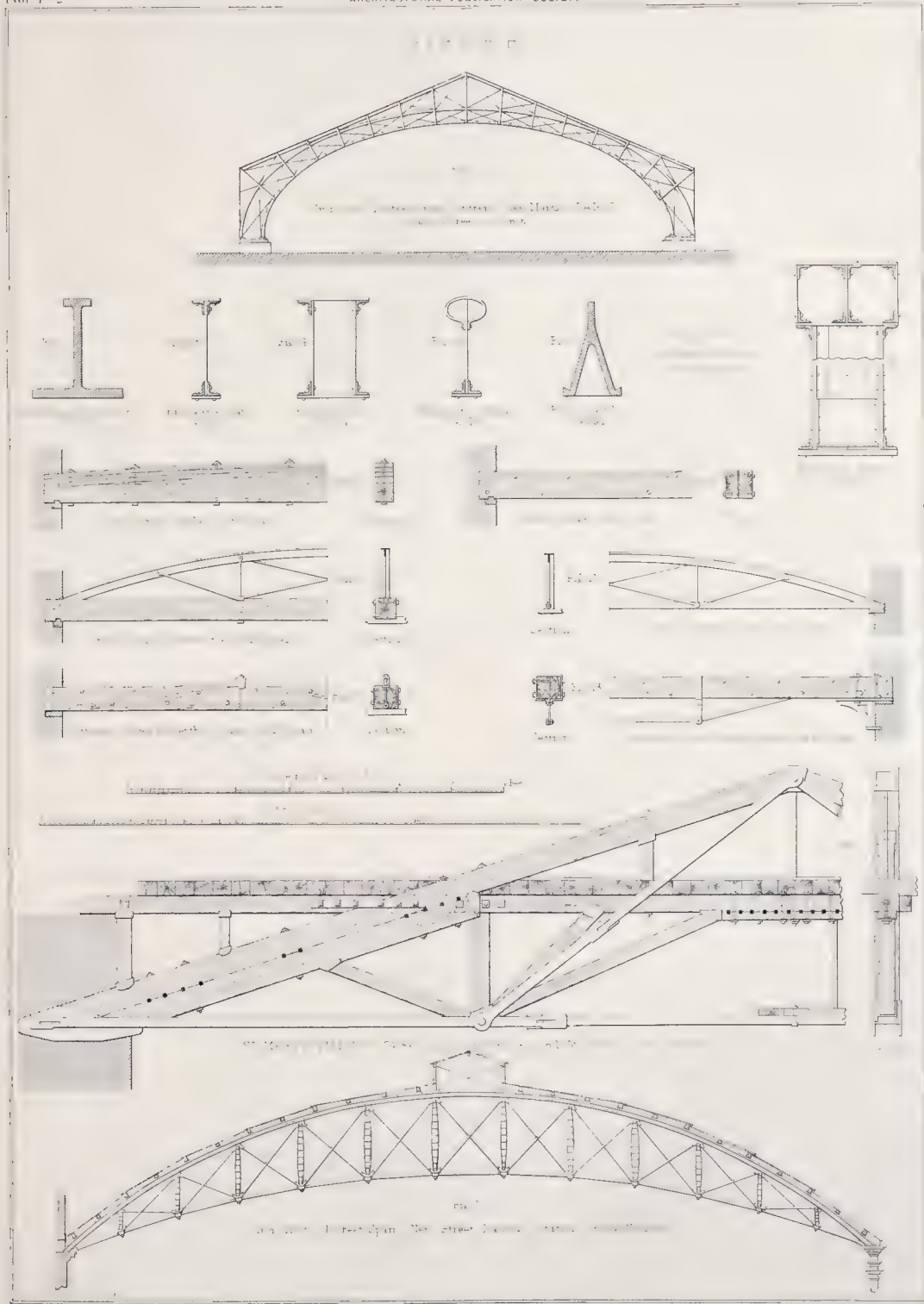
upon the centre of the bearing; a , represents the area of the bottom flange; d , represents the depth of the girder; c , the coefficient, varying according to the quality of the iron, but here taken at an average, 514; and l , the length of the bearing in inches, the other dimensions being also in inches, and the weights in cwt. In ordinary wrought iron beams, the area of the top flange is made $\frac{1}{3}$ greater than that of the bottom one, and the thickness of the centre web about $\frac{1}{4}$ to $\frac{1}{5}$ of the depth, under which circumstances the formula above quoted for cast iron beams may be applied, but making the coefficient, c , according to the quality of the iron, 1500 instead of 514. The top and bottom flanges of wrought iron *plate* girders are made of angle and *plate* iron riveted together closely: some engineers deduct the rivet-holes from the width of the bottom flange; thus a 16 in. flange with four rows of rivets is taken as a 14 in. flange; perhaps this is a safe proportion. **HOLLOW CAST IRON GIRDER; PLATE IRON GIRDER; ROLLED IRON GIRDER.**

When the length of the bearing is too great to allow the use of *simple* beams, *compound* girders, either *built*, *framed*, *trussed*, or *flitched*, are used; or else either *box*, or *tubular*, girders. *Built timber* girders are made by increasing the depth of the

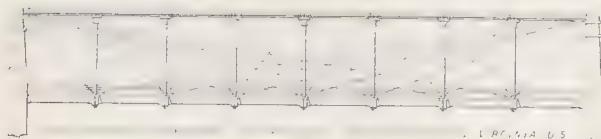
beams, by bolting several pieces of timber together, so as to obtain an artificial beam of the required strength. The most common form of girder thus built is that, in which the lower side is left perfectly horizontal, and the upper side is dressed off to the curve of a circle of large radius; upon this one or more concentric rings are added, and firmly bolted together; the strength of the beam being, if well put together, nearly the same as that of a solid natural beam of the same depth and width. *Framed* girders are rather more complicated in their structure than the built ones, and, indeed, are hardly distinguishable from the next variety, viz. *trussed* girders; in both of them additional strength is gained by combining the timbers in such a manner, as to cause each part to receive the strain to which it is exposed in the direction of its length; thus the Burr's girders are *trussed*, while the Town's lattice bridges depend for their strength on their lateral *framed* girders. In *trussed* girders, properly speaking, strength is gained by the introduction of a truss of wood or of iron, in which one portion of the material is so disposed, as to resist the effort of compression exercised on the top of the girder, and the remainder to the effort of extension exercised on the bottom. Every truss is, in fact, an arch tied together at the springing line; and a trussed girder consequently contains within itself such an arch, the dimensions and proportions of which depend on the load, the span, and the depth of the truss; but no trussed girder can be depended upon, where the truss is confined to the depth of the girder. **TRUSS.**

Flitched girders are those in which iron beams are introduced between wooden flitches; the iron being either cast or wrought, with or without flanges. Cast iron flitches to girders are almost always made with flanges, and their strength is calculated upon the usual formulas, without taking into account the strength of the wood on its sides; for the latter merely acts, in the majority of cases, to modify the outlines of the girders, to receive the tenons of joists, bearers, etc., and to counteract cross strains or torsion. The strength of wrought iron flitches with angle iron flanges is usually calculated in the same manner, i.e. irrespective of the timber; but in many cases flitched girders are used, in which flat plates are introduced between wooden beams, which not only act to prevent the buckling of the plate, but also contribute greatly to the strength of the whole. There are no recorded experiments on the resistance of these girders with plain wrought iron flitches, but they render very great service in building operations. The author of this note calculates the dimensions of these beams on the principle, that the strain on the girder should not produce any permanent extension of the iron, or affect the elasticity of the wood flitches bolted to it. **ROLLED IRON.**

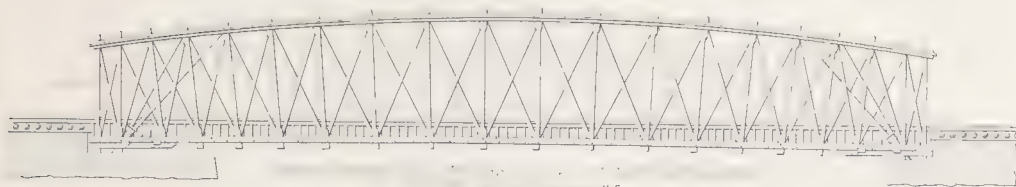
In the *reversed trussed* girder, now much used, which resembles a bow with the string uppermost, resistance is obtained by means of vertical struts placed under the tie-beam, which cannot deflect so long as the supports at the ends of the truss are maintained in their vertical position by the resistance of the bottom tie to the effort which tends to extend it: such beams might be adopted when the effort to be exercised does not exceed the powers of resistance of the beam, added to the powers of resistance of the truss to the weight brought upon it in a vertical direction; but they become useless when the weight brought upon the horizontal beam exceeds the powers of resistance of the latter, plus the resistance of the truss. Evidently, under these circumstances, the depth of the framing constitutes an essential condition of the powers of any such truss, as the resistance of the latter depends entirely upon that element, and upon the length and rigidity of the points of support. In a reversed trussed girder having the truss confined to the depth of the tie-beam (a practice above condemned for its insecurity) and the ends of the trussing-rod dependent upon the ends of the beam, it is evident that, if the beam should bend, the ends of the trussing-rod will approach each other, and that the work will fail.



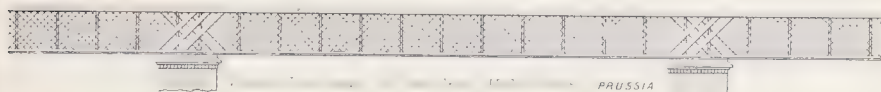




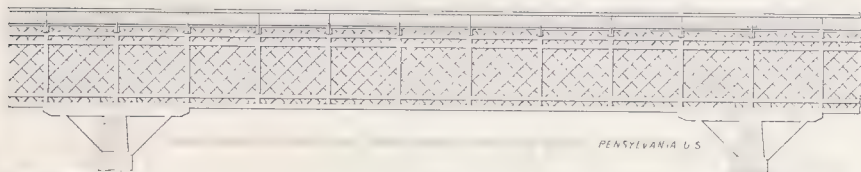
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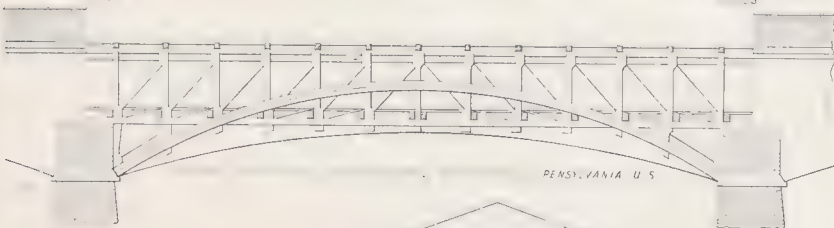
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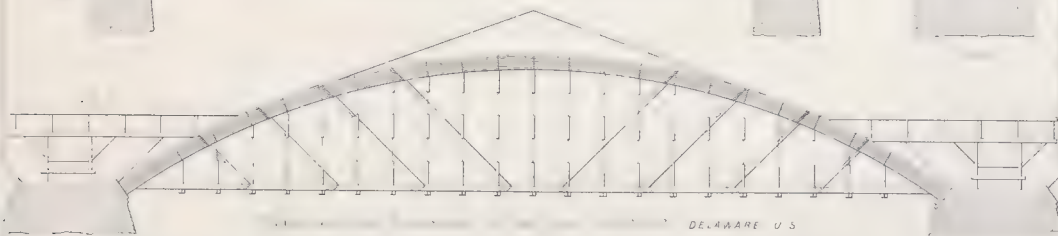
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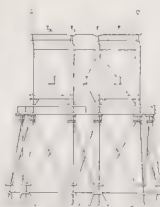
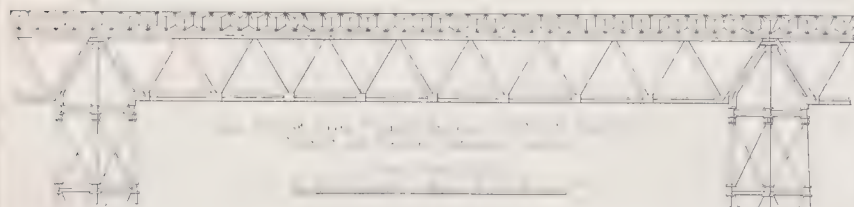
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The framed girder, known as the *box girder*, is so called from its form, consisting of two upright sides connected by a top and a bottom flange, presenting a box in section. It was upon these beams that the celebrated experiments for determining the girders to be used at the Britannia bridge across the Menai Straits were made, from which it would appear that tubes of a square section on plan are generally speaking of greater strength per square inch of sectional area than oval ones, or than round tubes, in the proportions of 18 to 15, and 13 nearly. But it is worthy of special remark, when calculating the strength of these more complex girders, that the resistance of the beam becomes greater from the combined support of the centre web acting to distribute the weight over a greater area; and that a simple framed girder in place of the centre web would secure the same result, with a diminished section of metal, if it were possible to introduce that form. The *tubular girder* is also inferior to the wrought iron flitched girder, in so far as this logical application of the material is concerned; and the former is therefore only resorted to when the assemblage of the tubes can be made to contribute to the strength of the structure in a way which could not otherwise be attempted. The following simple rules may be adopted in proportioning the dimensions of wrought iron girders of the *box* shape; thus, a = sectional area of top tube; b = the area of bottom; then $a = b + \frac{l}{3}$; and the span : depth :: cohesive

strain of the bottom flange : the breaking weight. In all ordinary cases the dimensions of the centre plates would seem only to be regulated by the facility of their application; and the thickness is usually made $\frac{1}{4}$ in. in the centre of the span, and $\frac{3}{8}$ at the ends, provided the bearing do not exceed 66 ft. span. FAIRBAIRN gives the formula for a *box girder* $w = \frac{c a d}{l}$, the references being the same as before. BOX BEAM; CELLULAR BEAM.

For the *oval* or *tubular girder* it is necessary to diminish the weight brought upon the bottom flange in the above quoted proportions. This form of girder is very much adopted in large engineering works, and it is peculiarly applicable when large spans have to be constructed, with few intermediate points of support. Indeed the success of the Britannia and of the Saltash tubular bridges seems to have turned the attention of engineers to the advantages offered by the introduction of wrought iron; but the relative merits of cast iron and of wrought iron girders have not been fairly brought to the test of experience. It must be, however, borne in mind that wrought iron girders admit the introduction of plate iron transverse beams with greater facility than do those of cast iron, and that therefore their application is more rational under those circumstances. This fact is quite independent of the manner in which wrought iron girders may be connected with the superstructure, whether by entirely suspending the girders to the bottom ribs of the beams as in the South Eastern extension line of railway in London, or by connecting them with the bottom ribs by resting upon those parts as in the Menai tubular bridge.

BOW AND STRING BEAM; CAST IRON; HOOP IRON BEAM; IMPACT; LATTICE GIRDER; SHOEING; SUSPENSION GIRDER; TRUSSED GIRDER; TUBULAR GIRDER; WARREN'S GIRDER; WROUGHT IRON.

G. R. B.

Besides the works and tables specially mentioned under such separate articles as those above named, the following have a general relation to this subject: ENGINEER, ARCHITECT'S AND CONTRACTOR'S *Pocket Book*, 8vo., London, 1861: the *BUILDER Journal*, containing, iii, 553, Depths of Cast Iron Beams: vi, 571, Tension-Rods as applied to Girders, by T. Cubitt: v, 593, 600, 612, Experiments on the form of Cast Iron Girders, made by G. B. Cooper for C. Parker, and read at Royal Institute of British Architects: viii, 352, Table of Safe Load for Cast Iron Beams, 6 to 16 ins. deep, if equally distributed, taken from BEARDMORE, *Hydraulic Tables*,

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8vo., London, 1850 and 1862: viii, 609, Deflection of Iron Girders: xiii, 309, Strength of a Beam supported by Props: xiii, 466, 490, New Formula for obtaining the *Safe Load* in place of the *Breaking Weight*, by R. H. Skaife, in these words, "FAIRBAIRN says that for bridges and warehouses, cast iron beams should not be loaded with more than one-fifth or one-sixth of the breaking weight; HODGKINSON's formula is $w = \frac{26 a d}{l}$, where w = breaking weight in tons in the middle,

a = area of bottom flange in inches, d = depth of beam in inches, and l = length between supports in inches"; the proposed formula is, " $s = \frac{26 a d}{l}$, where s = safe load in cwt. equally

distributed at one-fifth the breaking weight, a and d as above, and l = length between supports in feet": xvii, 764-5, Experiments by J. G. Lynde, C.E., on eighty-nine Iron Girders of Hodgkinson's section, cast at Manchester: and xix, 260, Girders, Beams, and Lintels, by C. H. Haswell, reprinted from the *Journal* of the Franklin Institute, being a condensed statement of the results obtained by previous authors.

The *CIVIL ENGINEER Journal* contains, v, 226-8, 334, Experiments on the Strength of Cast Iron Girders of large dimensions: viii, 381, Strength of the Cast Iron Girders at the Terrace Pier at Gravesend, 50 ft. and 22 ft. span, by Mr. Redman: xi, 258-64, Dynamical Deflection and Strain of Railway Girders, or the influence of moving loads, by H. Cox: xviii, 336, Skaife's formula, as above given: xx, 21, Wrought Iron Beams, by Thos. Davies, read at the Architectural Institute at Edinburgh Feb. 1856: xx, 41, Cast Iron Beams, by the same: 76, Fairbairn's Report on the Paris Universal Exhibition 1855: 323, Mechanical Effect of combining Girders and Suspension Chains, by P. W. Barlow: xxv, 35, Stresses on various parts of a Bow-String Girder, by R. H. B.: and 147, etc., The Economic Construction of Girders.

The *BUILDING NEWS Journal* contains, ii, 249, Experiments on Girders at the Marquise Iron Works in France, by M. Guettier, C.E.: and iv, 87-90, Construction and Uses of Wrought and Cast Iron Girders, by G. Mortimer.

GIRDER BRIDGE. The name given to a bridge formed of horizontal bearers in contradistinction to the arch, and the suspension, bridge. The varieties are named above, and *s. v.* BRIDGE, as well as referred to in the separate articles. It may be added that of late years the use of cast iron and of wrought iron as beams for girder bridges has made a considerable difference in the practice of engineers, in the manner of erecting them. The following books are in addition to those already given *s. v.* BRIDGE, for examples in respect of both of the above articles; HUMBER, *Practical Treatise on Cast and Wrought Iron Bridges and Girders, as applied to Railway Structures and to Buildings generally*, fol., London, 1856-7; HASKOLL, *Assistant Engineers' Railway Guide*, 8vo., London, 1846-8, 97; DALY, *Revue Générale* (Wrought Iron Girders), xvi, 78, pl. 21-2, 268, pl. 57-8; HAUPT, *General Theory of Bridge Construction*, 8vo., New York, 1851; WARR, *Dynamics*, etc., 8vo., London, 1851; SEGUIN, *Des ponts en fil de fer*, 8vo., Paris, 1824; DEMPSEY, *Malleable Iron (Tubular) Bridges*, 4to. and fol., London, 1850; and *Tubular and other Iron Girder Bridges*, 12mo., London (Weale), 1850; and *Iron applied to Railway Structures*, 4to., London, 1850; BLAIR and PHILLIPS, *On the Construction of Viaducts, Bridges, etc.*, 8vo., London, 1845; CLAYTON, *On Bridges and Viaducts of the Present Day*, *Transactions of the Royal Institute of British Architects*, 1855-6, 133-42; and *The Statics of Bridges*, in several numbers of the *CIVIL ENGINEER Journal*, xxiv, and xxv.

GIRDING BEAM. A name formerly given to a girder. 4.

GIRDLE. The circular band round a column. 1. 2. 19.

GIRGENTI (Gr. Ἀγρῆγας; Lat. *Agragus* and *Agrigentum*). A city on the southwest coast of Sicily. It was founded about B.C. 582 or 572, and rose to such prosperity that the chief buildings now remaining seem to have been erected by the

labour of the Carthaginians taken captive B.C. 480 and of their descendants until B.C. 406, when the town was so thoroughly devastated by the Carthaginians as to remain abandoned until B.C. 344-337. The principal works upon those edifices, viz. BIANCHI and CUCCINIELLO, *Viaggio Pitt.*, fol., Naples, n. d.; CASSAS and BENCE, *Grandes Vues*, fol., Paris, 1813; HOUËL, *Voy. Pitt.*, fol., Paris, 1782-7; WILKINS, *Magna Græcia*, fol., Cambridge, 1807; and GOLDCUTT, *Antiq. of Sicily*, fol., London, 1819, pl. 12-19, may be considered to be superseded so far as the most recent discoveries are concerned by LO FASO PIETRASANTA (duca di Serradifalco), *Antichità di Sicilia*, fol., Palermo, 1834-42, iii, which gives amongst other engravings a plan of the city; of the dystyle temple in antis to Ceres and Proserpine, now the church of S. Biagio; the hexastyle peripteral amphiprostyle temples to Juno Lacinia, to Concord, and to Hercules; the tomb of Theron; the temple to Æsculapius; the gigantic temple to Jupiter Olympius; the temple to Castor and Pollux; the remains of a stoa; the temple of Vulcan; and the tetrastyle oratory of Phalaris. He observes that most of these names have been affixed without any great reason by preceding archaeologists, and insists upon the authority for external polychromatic decoration derived by him from the ruins of the temples to Hercules and to the twin-brothers. Amongst the noticeable features of these structures are the staircases in the naos of the temples to Juno, Hercules, and Concord, which last deserves consideration in any investigation of the subject of a hypæthral temple; the parapet shown by SERRADIFALCO upon the level and raking cornices of the temple to Hercules; the enormous statues, with the bases and the mode of building the columns, of the temple of Jupiter Olympius; and the capitals of an Ionic order with angular volutes carrying a Doric entablature to the tomb of Theron. Illustrations of the temple to Concord are given, at a large scale, by GAERTNER, *Ansichten*, fol., Munich, 1819.

HITTORFF observes that the architects of these works were obliged to change the details, but reproduced the proportions of the temples to Minerva and to Theseus at Athens; that the columns of the temple to Æsculapius were of the same dimensions as those to the Parthenon and Propylæa at Athens; that at the temple to Jupiter Olympius, the columns, the statues, and the gigantic figures were alike engaged in the walls; that the temples of Hercules, Concord, Jupiter Olympius, the Gemini, and Juno were probably built in the order just given, between 480 and 406 B.C.; and that there was a species of drum made of hewn stone in front of the three cells in the nave of the temple to Hercules. The local shelly stone was coated, to conceal its great porosity, with a polished stucco painted, while the moldings of cornices were executed in a hard and finely grained stone. With regard to the temple of Jupiter Olympius, it should be stated that although three of the gigantic figures and some of the columns did not fall until 9 December 1401, as mentioned by FAZELLUS, *De Rebus Siculis*, fol., Palermo, 1558, p. 127, no tradition assists in fixing the position of the entrances, or in deciding the places of the Atlantes: DIONORUS, noticing that the destruction of the town B.C. 406, prevented the completion of the building, adds its size as being 340 ft. long, 160 ft. wide, and without the substructions 120 ft. high of the measure employed by him: in English feet the top step was 360 ft. long and 173 ft. 4 ins. wide, as calculated from the dimensions given in STUART, *Athens*, etc., supp. vol., fol., London, 1830, by C. R. Cockerell, R.A., who gives 13 ft. as the diameter of the columns, which are the largest in diameter of any existing known remains, calculates the weight of each stone forming a quarter of the echinus (peculiarities are shewn in the section by WILKINS, ch. iii, pl. 16) at 21½ tons, and suggests a restoration which may be compared with the plates in KLENZE, *Der Tempel*, fol., Stuttgart, 1821; with those in POLITI, *Lettera*, fol., Palermo, 1819; and with others in SERRADIFALCO. SIEFERT, *Akragas*, 4to., Hamburg, 1845.

The funeral monuments were of three kinds, viz. subterranean tombs which consist of several square and circular chambers within the city, all the decoration being destroyed; a wall of columbaria, formed by arched hollows in the face of the rock, between the table land and the necropolis; and the necropolis itself, formerly magnificent, but now only marked by the so-called tomb of Theron.

The modern cathedral, dedicated to the Assumption of the Virgin and S. James, has some classic remains, and is chiefly remarkable for a curious echo; the only other important buildings are the episcopal palace, four churches, eleven monastic establishments, the extensive ecclesiastical seminario, and the town-hall. BUILDING NEWS *Journal*, iv, 558, 606. Many doors, windows, and other details are met with of Norman architecture, in which the chevron ornament is profusely used; a peculiarity the more notable from the general absence of that ornament in Italy: *Recollections of Sicily*, by S. SMIRKE, R.A., in the *Transactions of the Royal Institute of British Architects*, 1859-60, p. 1.

GIRNAR or GIRRAJ. The name of a hill in Saurashtra (Western Hindostan) on which exist a palace of Khenkar and several Jain temples, illustrated in TOD, *Travels*, 4to., London, 1839, p. 379.

GIROLAMO IL TEDESCO. The name, according to the *Handbook for Northern Italy*, 12mo., London, 1856, p. 336, of the architect who rebuilt the fondaco de' Tedeschi at Venice after the fire 1505; but the design is ascribed in the *Handbook*, 1842, p. 349, to G. Giocondo; and by TEMANZA, *Vite*, i, 90, to Pietro Lombardo.

GIRONA, in Spain, see GERONA.

GIRT. One of the terms used for a fillet or listel by workmen; NEVE, *Dict.*, 1732, s. v. *fillet*.

GIRT or GIRTH. The length, from one point to another, along the section of any molded surface. It is generally measured by means of a piece of string in the case of painters' work to moldings; but by a lead tape in taking copies of executed details. MEASURE OF TIMBER.

GIRT LIGHT. A provincial term for a casement frame having mullions and a transom. A. W. M.

GISOLEI or GRISOLFO (ONOFRIO), architect to the king, commenced for the Padri Pii Operarij the new church of S. Nicolo alla Carità, called S. Nicolliello, at Naples, which was continued by C. Fansaga. 95.

GISORS, written by German authors GIZORS (GUY DE), erected at the end of the second court of the palais Bourbon at Paris, the Corinthian columns marking the salle des séances, salle du corps législatif, or salle des cinq cents, of which the decorations externally and internally were designed by him, as well as the roof of that salle, given in KRAFFT, *Charpente*, fol., Paris, 1802-5, pt. ii, 20, pl. 54; and the turning scaffold given 26, pl. 76; in which Lecomte and Gisors are noticed as the architects to the building. The same author, in the *Charpenterie*, 1819-22, iv, pl. 20, gives the framing of the roof of the abattoir designed by Gisord (*sic*) at Grenelle. GOURLIER, etc., *Choix d'édifices*, fol., Paris, 1825-50, i, pl. 7, 8, and 50, give the parish church of S. Vincent at Mâcon (partly executed by Guillemot) as designed 1810 of an Ionic order by Gisors, who became vice-president of the conseil des bâtimens civils. His nephew Alphonse de Gisors is still in practice.

GITTARD, sometimes written GITARD (DANIEL), continued after the death 1704 of Le Duc, the church of the Augustins Dechaussés or Petits-Pères, in the place des Victoires at Paris, which was completed about 1739 by Cartaud. BLONDEL, *Cours*, 8vo., Paris, 1771, ii, 323, states that this work was commenced by Gittard, who had probably acted on it as assistant to Le Duc: for BLONDEL, *Arch. Franç.*, fol., Paris, 1752, ii, 37, giving the church of S. Sulpice, intimates that Gittard continued that church after the death 1670 of Le Vau, and until the works were stopped in 1675, and ascribes to him the choir, the ailes, great part of the left transept, and the first order of

the north entrance; while VIRLOYS, *Diet.*, s. n., considering that these works were chiefly built by Gittard as assistant to Le Vau, allows that he designed the *escalier en limaçon* behind the chevet, and also the north portal. Gittard built 1644 the hôtel de S. Simon, called after 1715 de la Force, in the rue Taranne, shewn in the *Arch. Franç.*, i, 295; and probably about the same time the hôtel de Cossé in the same street, or rather in the rue de S. Pere, as noted by BRICE, *Descr.*, 12mo., Paris, 1725, iv, 56), according to the *Cours*, vi, 489; as well as another hôtel in the rue des Petits-Champs, according to VIRLOYS, which is probably the house of J. B. Lully in the rue neuve des Petits-Champs, nearly opposite the rue des nouvelles Catholiques, as mentioned by BRICE, i, 412. He also designed for the church of SS. Jacques et Philippe du Haut-Pas in the faubourg S. Jacques, the portal, the first stone of which was laid 19 July 1675; it is shewn in the *Arch. Franç.*, ii, 74. NAGLER, *Lexikon*, s. n., attributes to him the whole design of that church, and the restoration of the château de S. Maur. He was one of the eight original members of the Academy of Architecture at Paris, founded 1671; and died 1687, leaving a son who is recorded in the registers of that academy as "GITTARD fils, regu 1699."

GITZORS, see GISORS (GUY DE).

GIUDETTO executed 1204 the west front of the church of S. Michele at Lucca; WEBB, *Sketches*, 8vo., London, 1848, 396, gives 1070 as the date. 28.

GIUDICI (CAROLUS JOHANNES FRANCISCUS), born at Como 5 January 1746, passed the greatest part of his life in Holland, where he filled several appointments. Having studied architecture at Como, he went to Rome and other cities of Italy; and settled at Rotterdam. The second prize was awarded to him for a design for the town-hall at Groningen. His principal works were; at Rotterdam, the Roman Catholic church in the Leeuwenstraat; the government dock yard; the arsenal (now the barracks); the concert room; a brewery; several of the finest private houses; and the organ in the great church; at Helvoetsluis, the arsenal and many other works; at Leyden, the Roman Catholic church and orphan house; and the hall of the drapers. The fine mansion called Palensteyn near Zegwaard, and the organ at Voorburg, are also amongst his best works. In 1781 he made a design for a new town-hall at Rotterdam, and another for the partial renewing of the old edifice. In 1807 he was commissioned by the king Louis Napoleon to repair the government buildings, greatly damaged by an explosion; and also to plan the new town of Assen. He was appointed architect and general inspector of all the buildings belonging to the admiralty of the Maze and Flushing, which office he resigned in 1811. He died at Rotterdam 11 May 1819. 24.

GIULIO ROMANO, see PIPPI (GIULIO).

GIUSSANI (MAFFIOLO), and GUISSANO (GIOVANNI DA), a Dominican, appear under the dates 1503 and 26 March 1401 respectively, in the list of architects engaged on the cathedral at Milan. 27.

GIUVARA, see JUVARA (FILIPPO).

GIZEH, in Egypt, see MEMPHIS.

GLACIS. The name, adopted by landscape gardeners from the science of military engineering, for a steep slope of ground rising from one artificial or natural level to another.

The 'glacis of the cornice' is an easy imperceptible slope in the cymatum of the cornice to promote the descent and draining off of the rain water. 13.

GLAETZEL (CONRAD), with Heinrich Schnellmeier, built 1425-39 (towers were contemplated, but have not been erected), the church of the Virgin at Ingoldstadt; GERSTNER, *Geschichte von Ingolstadt*, 8vo., Munich, 1853, p. 82. 68, 92.

GLANDELAGH or GLENDALOGH. An ancient episcopal see in the county of Wicklow in Ireland. Although destroyed with its churches by fire at least thrice in the eleventh century, it had many inhabitants until about 1400. S. Kevin, who died

3 June 618, is said to have chosen this site for his abbey, which fulfilled the purposes of modern universities, was burnt 1163, and is still to be traced in the ruins of two buildings, the most southern having been the church. A little to the north of them is Trinity church, which has lost since 1786 from its front a circular building on a square base with a space in it that seemed intended for the rope to the belfry. The ruins of a granite gatehouse mark the entrance to the area containing the seven churches (for that number is insisted upon here, as in other parts of Ireland), which consist of the church of the Virgin; the Rheafert or sepulchre of kings, seven princes being buried there, inclusive of the MacThuill, who died 1010; the eastern church, or priory of S. Saviour; the Ivy church; the priory of the Rock, or temple of the desert; all more or less in ruins; with the better preserved chapel called S. Kevin's Kitchen, 23 ft. long and 15 ft. wide, having (through a hole in the vault serving as a floor to thecroft or room beneath the stone roofing) an entrance to a round turret rising to the height of about 45 ft. from the west gable of the chapel; and the former cathedral, dedicated to S. Peter and S. Paul, which is 48 ft. long and 30 ft. wide, and exhibits more strongly than the rest a Romanesque character; the neighbouring, but unroofed, round tower is about 110 ft. high and 16 ft. 6 ins. in external diameter. A monolithic cross, 11 ft. high, is also comprised in the long description of these ruins given by ARCHDALL, *Mon. Hib.*, 4to., Lond., 1786, pp. 765-76 (reprinted in WARBURTON, *Hist. of Dublin*, 4to., Lond., 1818, pp. 252-63), who considers that a groove at the east end of S. Kevin's kitchen proves the existence there of another round tower previous to the erection of the now contiguous ancient buildings. Parts of the edifices named above are noticed in WILKINSON, *Practical Geology*, 8vo., London, 1845, pp. 81 and 145, who gives, p. 94, a view of S. Kevin's kitchen, and mentions, p. 197, the materials employed, viz. granite for quoins, and slate rock for rubble; and in the *Transactions of the Royal Institute of British Architects*, 1857-8, by HILLS, *Review*, p. 74; and DONALDSON, *Wayside Memoranda*, p. 150-2. It forms one of the best localities for the study of early buildings in Ireland.

GLANUM LIVII. The Latin name for S. REMY, in France.

GLAPHAM (ADAM DE), magister cœmentariorum with his seven fellows (sociis) were employed at the building of Caernarvon castle in 1298; DALLAWAY, *Discourses*, 8vo., London, 1833, 421, quoting Lib. Garderoba, 26 Edward I. ELLERTON.

GLASGOW. A city in the county of Lanark in Scotland. It embraces an area of 5,658 acres, the circumference being sixteen miles, and is situated on the river Clyde, over which are six bridges; *Hutcheson's*, erected 1829-32 by R. Stevenson, C.E., is 404 ft. long and 38 ft. wide, having five arches, two being 65 ft., two 74 ft. 6 ins., and one 79 ft. span; it cost £30,000 (HANN and HOSKING, *Bridges*, 8vo., London, 1843, 101-37, 185, pl. 27-33; COMPANION TO THE ALMANACK, 1834, 230): *Glasgow*, formerly called Old Broomielaw, or Jamaica-street, rebuilt 1833-5 by T. Telford, C.E., is 560 ft. long and 60 ft. wide, having seven arches, faced with Aberdeen granite, it cost £34,000, or £40,000 including compensations: *Victoria*, on the site of the Old or Stockwell-street, 1851-4 by J. Walker, C.E., is 451 ft. long and 60 ft. wide, having five arches, the centre one being 80 ft., the others 76 ft. and 67 ft. span respectively; it is of Dublin Bay granite, and cost £40,000: *Portland-street*, a suspension bridge, 1850-3, by G. Martin, C.E., having one span of 414 ft., and 16 ft. in width, cost £8,000; this replaces a timber bridge, built 1831-2 by R. Stevenson, of fourteen openings, each 34 ft. span and 32 ft. wide (HANN, lxxxiii, pl. 6-9): *S. Andrew's*, a suspension bridge, 1855 by Niel Robson, C.E., 220 ft. long and 12 ft. 6 ins. wide, it cost £5,500: and *Rutherglen*, 1776 by J. Watt, C.E., of stone. The *harbour* or Broomielaw, a part of the river, is lined with quays and extends from Victoria bridge to the mouth of the Kelvin, a distance of two miles and a quarter;

but the working part is one mile and a quarter in length; the quay walls cost from £30 to £80 per lineal yard exclusive of dredging, etc. The sheds cover an area of about 40,000 square yards; one lately finished, 1462 ft. long and 60 ft. wide, cost about £20,000.

All the old timber dwellings are removed: some of the old closes, however, are narrow, wretched places. The new streets, varying from 50 to 100 ft. in width, are clean, well lighted since 1818 with gas, and paved with granite blocks from Loch Fyne and blue basaltic whinstone, with flag foot pavements. All the buildings, with the exception of the factories, are built of a fine white, generally wrought or "polished", freestone from the quarries at Giffnock and Kenmuir, about three miles to the north and south of the city. The houses for the working classes are generally four stories high, each floor reached by a stone staircase 8 ft. wide; and containing two or three distinct dwellings of one, two, or three apartments, let at £5, £9, and £14 per ann. each dwelling; the more recently erected have a water closet and sink. For the middle class the buildings are of the same height, with one or two distinct dwellings on each floor, of four, five, six, and seven rooms, each set having a bath, water closet, and sink, and rented at £20, £30, £40, and £50 per annum. Some of the middle and upper classes have self-contained houses of three to five stories high. The drainage is now in course of construction by John Carrick, city architect, and consists of sixty miles of common sewers, of which nineteen miles have been formed since 1848; they range in size from 2 to 5 ft. wide, are egg shaped, and fall into the river. The Glasgow water works, erected 1806, and the Cranston hill water works, 1808, are described in the CIVIL ENGINEER *Journal*, 1843, 320-1; but an Act of Parliament was obtained in 1855 for bringing a supply from Lock Katrine, thirty-four miles distant; the works by J. F. Bateman, C.E., of London and Manchester, which cost about £800,000, were opened by the queen 14 October 1859; *BUILDER Journal*, xvii, 701, 849; xx, 2; *ILLUSTRATED LONDON NEWS*. The company's office in Miller-street, 1860 (Italian), by Messrs. Clarke and Bell, cost £5,000. The parks consist of the 'Green' of about 140 acres; Kelvingrove park, of 40 acres, bought in 1855 for £70,000, was laid out by Sir J. Paxton and C. Wilson; and 'Pathead' now Queen's park, of 140 acres, on the south side, purchased in 1857 for £30,000, has since been laid out by J. Carrick, under Sir J. Paxton's direction.

The public memorials comprise that of Nelson, 1 Aug. 1806 by D. Hamilton, an obelisk 144 ft. high, cost £2,000; an equestrian statue in metal of king William III, 1735; a bronze statue of Sir John Moore, 1809 by J. Flaxman; another of James Watt, 1824 by Sir F. Chantrey; a fluted Doric column surmounted by a figure in freestone of Sir Walter Scott, 1838 by D. Rhind; a bronze statue of Sir R. Peel, 1859 by J. Mossman; another of James Oswald of Auchincruive, late M.P. for the city, by Baron Marochetti; who executed an equestrian statue of the duke of Wellington 1844, cost £10,000; and another of queen Victoria, 1854: a marble statue of W. Pitt, 1812 by J. Flaxman, now in the corporation gallery; another of James Watt, by Sir F. Chantrey, in the Hunterian museum; and of Kirkman Finlay of Castletoward, late M.P. by J. Gibson, at the Merchant's hall.

There are numerous (upwards of 150) places of public worship of all denominations. The cathedral or high church, dedicated to S. Kentigern, commonly called S. Mungo, founded 1123, and consecrated 7 July 1136, was burnt 1192, the present crypt was commenced about 1240, the choir at the end of the thirteenth, and the nave in the fourteenth century. The plan is a cross with very short transepts, with a tower at the intersection 25 ft. 6 ins. square inside, rising 30 ft. above the roof, with a spire dating about 1420; its total height is 219 ft. from the floor of the nave. The chapter house, 30 ft. square inside, was completed 1457; the north aisle was roofed between 1455-73; the crypt of what would be the south transept, or

Blackadders aile, 55 ft. long and 26 ft. 8 ins. wide, dates about 1500. John Murdo or Murvo, a Frenchman, claimed to have had charge of the building about the middle of the fifteenth century. It was formerly stated that this building was saved from mutilation in 1570 by the stand of the townspeople, led by the dean of Guild, but lately this has been disputed. A tower at the west end 1400-25, was removed about 1848. The whole structure has been restored by the government; the crypts since 1835 by — Nixon under E. Blore, F.S.A.; the remainder since 1845 under R. Mathieson, at a cost of about £17,000, not including the stained glass windows, those of the nave and choir, (designed by the leading artists of the German school and painted at Munich) were inserted since 1857 chiefly by private donations, under the direction of C. H. Wilson; those in the crypts and chapter house are by British and foreign artists. The crypt under the choir is 95 ft. 2 ins. long, and under the Lady chapel 28 ft. 9 ins. long, both being 61 ft. 10 ins. wide and 17 ft. 5 ins. high; that under the chapter house is 28 ft. 9 ins. square. These portions, called the lower church, comprise the finest monument of its kind in Great Britain, and has few rivals on the continent; a respond in a dark corner may date in the twelfth century; *RICKMAN, Attempt*; *BELLINGS, Baronial Antig.*, 4to., London, 1852, iii; *FERGUSON, Handbook*, 8vo., London, 1855, ii; *ILLUSTRATED LONDON NEWS*, 1849, xv, 140; *COLLIE, Plans, etc., of G. Cath.*, fol., London, 1835, which work supplies the following other dimensions. The length of the nave internally is 151 ft. 3 ins. to the screen and 62 ft. 6 ins. wide; the choir is 103 ft. long to centre of the piers, and the Lady chapel 28 ft. 9 ins. long, both being 63 ft. 2 ins. wide; the height of the nave to top of arched ceiling is 76 ft. 6 ins., and that of the choir 73 ft. 7 ins.

Among the structures of the *Established Church* are; the New Barony, 1798-1802 (in a Scotch style) executed in a coarse manner after a design by J. Adam: the college or Blackfriars in High-street, 1699 in a rude style; the steeple, 1637 of the old Tron or Laigh church, 126 ft. high (Perpendicular style in the lower portion, and Jacobean above) stands on the pavement; it was restored and opened up on the ground floor 1855 by J. Carrick: S. Andrew, 1739-56 by Mungo Naismith, mason, with a portico of six columns of the Corinthian order, being a copy of S. Martin-in-the-Fields, London, except the tower, cost £15,000; the gallery front and pulpit are of mahogany: S. Enoch, rebuilt 1810 by D. Hamilton (Roman), having a simple Ionic tetrastyle portico; the steeple, 1780 by James Jaffrey: S. George, 3 June 1807 by W. Stark (Roman); the tower, 162 ft. 6 ins. high, has considerable originality: Gorbals, 1806 (Roman), with a spire 160 ft. high, by D. Hamilton, who also erected S. John, 1817 (Perpendicular); and S. Paul, 1835 (Grecian Ionic), with a tetrastyle portico without pediment: S. David or Ram's Horn, 1824 by T. Rickman (a fine specimen of Early English): Sandyford, 1856 by J. T. Emmett of London (Decorated): Park, 1858 by J. T. Rochead (Early Decorated), with a tower 100 ft. high, cost £8,000; and S. Mark, 1861 by J. Salmon (Early English), cost £3,000.

The *Scottish Episcopal* churches are S. Mary, Renfield-street, by the late J. Scott (Perpendicular): S. Andrew, Greenhead-street: S. Jude, Jane-street, Blytheswood-square, 1840 by the late J. Stevens (Grecian): and S. John, Cranston-hill, 1848 by the late J. Henderson of Edinburgh (Early English), cost £3,000. The chief of the *Free churches* are S. John, 1845 by J. T. Rochead (Mixed French), with a spire 180 ft. high, cost £5,600: Anderston, 1848 by Messrs. Clarke and Bell (Collegiate Gothic), cost £6,500: S. Mark, 1848-9 with a spire 180 ft. high, cost £6,000, by J. Salmon (Decorated); who also built in the same style S. Matthew, 1849-51 with a spire 200 ft. high, cost £12,000: S. Peter, 1845 with a spire 150 ft. high, cost £7,000, by C. Wilson (Early English); who also built in the same style S. Stephen, 1850, cost £5,000: S. Luke, 1849 by J. Wylson of London (Early English): Renfield, 1857-8 with octagonal tower, cost £10,000, by Messrs. Boucher and Cous-

land (Geometric Gothic); who have also built Kinning Park, 1862 (Romanesque), cost £4,000: Well Park, 1854 by Messrs. Hay of Liverpool (Decorated), cost £8,000; Briggate, 1859-60 by C. Douglas (Early Pointed, to harmonize with surrounding old Scotch buildings), with a gable roofed tower 120 ft. high, and an open air stone pulpit, cost £3,412: and Kelvin-side, 1862 by C. Douglas and Stevenson (Early French), with detached tower and spire, cost £5,000. The *United Presbyterian* churches are those in S. Vincent-street, 1859 with a hexastyle Ionic portico, and a campanile 170 ft. high, cost £14,500 and the site £2,500, by Messrs. A. and G. Thomson (Greek Ionic); who have also built in the same style that in the Caledonian-road, 1856, with a campanile 130 ft. high, cost £7,000: Albion-street, 1824 with a tetrastyle Doric portico, by the late J. Baird (Roman); who also built Wellington-street, 1825 (Grecian), with a tetrastyle Ionic portico after the temple on the Ilyssus: Renfield-street, 1849 by James Brown (Perpendicular), cost £14,000: Berkeley-street, 1855 by J. Burnet (Decorated), with nave and aisles lighted chiefly from the clear-story, cost £3,500: Claremont-street, 1855 by Messrs. Hay of Liverpool (Decorated), with nave and aisles, cost £10,000: John-street, 1859 by J. T. Rochead (Italian), cost £8,000: and that in the Great Western-road, 1862 with a spire 200 ft. high, cost £9,000, by J. Honeyman, jun. (Early English). The chief *Independent* churches are Bath-street Congregational, 1849 by J. T. Emmett of London (Decorated), the best specimen in the city, a nave and aisles, with a spire 225 ft. high, cost £14,000: Elgin-place, 1856 by J. Burnet (Grecian Ionic), lighted chiefly from the roof, with a hexastyle portico after the temple of Erechtheus, cost £12,000: Ewing-place, 1858 by Messrs. Barclay and Watt, with a Roman Doric tetrastyle portico, cost £7,400: the Evangelical Union church, Cathedral-street, 1856 by J. Burnet (Scotch Perpendicular), cost £3,500: the Catholic Apostolic church, Parliamentary-road, 1852 by J. Salmon (Early English), cost £5,000: the Macdonald Mission church, Maitland-street, 1861-2 by Messrs. Douglas and Stevenson (Early French), with slated spire about 130 ft. high, cost £2,767: and the Unitarian chapel, S. Vincent-street, 1856 J. T. Rochead (Grecian Ionic), cost £3,000. The Roman Catholic chapel of S. Andrew's, 1814 by the late J. Gillespie-Graham of Edinburgh, cost £13,000.

There are three cemeteries worthy of notice; the Necropolis or Fir-park, near the cathedral, has been compared with that of Père la Chaise at Paris; the chief architectural works are the bridge spanning the valley of the Molendinar, and the entrance lodge, both by D. Hamilton; the façade to the intended catacombs is by J. Bryce: the Sighthill cemetery, 1839, has the gateway and chapel by the late J. Stevens: and the Southern Necropolis, 1840, the buildings by C. Wilson.

Among the educational establishments are the university, founded 1450; the street front, 300 ft. long, of Jacobean character, dates 1630-62; the first court, 88 ft. by 44 ft., contains a massive stone stair 1690 leading to the common hall; the second is 103 ft. by 79 ft., the east side was rebuilt 1810-11; the building in the Grecian style separating this from the third court, is by P. Nicholson; the third contains the Hunterian museum, 1804-5 by W. Stark (Roman Doric), costing £10,000, and the library, cir. 1740 by W. Adam (Roman), but unfinished, in which are upwards of 101,000 volumes; the fourth contains the professors' residences; *BILLINGS*, ii: the Free church college and college church, 1856-61 by C. Wilson (Italian), cost £22,000: the Free church training college, or Free normal seminary, by the late T. Burns; the additions 1861-2 by C. Douglas (Early Perpendicular), cost £2,171: the normal school, 1838 by D. Hamilton; who also designed the Hutchison school, 1840, cost £4,236: the collegiate school, Garnet-hill, 1840 by J. Smith (Grecian), cost £3,500: the Glasgow academy, 1845 by C. Wilson (Italian), cost £12,000: and Alexander's charity school for 800 pupils, male and female, 1858 by J. Burnet (Italian), cost £6,000.

ARCH. PUB. SOC.

The public buildings comprise the royal exchange, considered the best building in the city, erected 1829-30 by D. Hamilton (Corinthian), at a cost of £50,000; it has a lofty octastyle portico, two columns in depth; with a circular campanile surrounded with Corinthian columns, containing a clock and bell; the news room is 130 ft. long by 60 ft. wide, with a coffered ceiling 30 ft. high supported by Corinthian columns; the reading room is 74 ft. long by 32 ft. 6 ins. wide and 16 ft. 6 ins. high: the post office, 1855 by W. Burn of London: the corn exchange, 1841-2 by Brown and Carrick (Italian), is externally 85 ft. 6 ins. long by 63 ft. 6 ins. wide, having a hall 80 ft. long by 57 ft. wide and 21 ft. high at the sides, and 34 ft. in the centre, cost £4,200 (*COMPANION*, 1844, 242-4); it was altered and enlarged 1858 by Messrs. Barclay and Watt, making the hall 119 ft. long and 85 ft. 6 ins. wide, and the cost £5,500: the municipal and county buildings and merchants' house, 1844 by Messrs. Clarke and Bell (Grecian); the former erection cost £20,000, the latter £10,000: the gaol and public offices or judiciary courts, 1810 by W. Stark, consisted of three public courts, and was 215 ft. long and 114 ft. wide, with a portico of six Grecian Doric fluted columns on steps; cost £28,000 exclusive of the site, and £40,000 altogether; it was remodelled 1845 and further extended 1859 by Messrs. Clarke and Bell, at a total cost of £12,000: the town-hall building near the cross, rebuilt 1781 by W. Hamilton, consists of a range of Ionic pilasters over a rusticated arcade, and contains a hall 55 ft. long by 34 ft. wide and 25 ft. high: the old tol-booth or gaol adjoining, 1636, was removed 1812, leaving the square tower or 'cross steeple' 126 ft. in height, which is terminated by a stone crown so often seen in Scotch architecture; it projects over the pavement, and was pierced for a footpath 1846 by the late J. Baird: the city hall, 1840 by G. Murray; the hall is 150 ft. long, 65 ft. wide, and 34 ft. high, cost £9,000; the organ 1855 is one of the three largest in Great Britain except that at York: the bridewell, 1789 from designs by J. Paterson, and afterwards by J. Herbertson (castellated style): the poor-house for the parish of Govan, in Eglinton-street, formerly the cavalry barracks: the workhouse (late the lunatic asylum, with its fine stone dome, 1809-10 by W. Stark, "the best asylum in Britain at the time of its erection", cost £18,000, *STARK, Public Hospitals*, 4to., Edinb., 1807) is now superseded by the extensive lunatic asylum at Gartnavel, 1844 by C. Wilson (Tudor), cost £36,000: the Glasgow barony parish poorhouse at Barn-hill, said to be the largest habitable building in Scotland, 1849-51 by Messrs. Clarke and Bell (Italian) for 3,500 persons, cost £22,000: the house of refuge (for boys), 1838 by J. Bryce (Italian); with others for the blind and dumb; and the Magdalen asylum 1802: the royal infirmary, 1792-4 by R. and J. Adam, had then beds with cast iron frames for 240 persons; to this has been added the fever hospital for 220 persons, by G. Murray; and the surgical hospital, 1861 by Messrs. Clarke and Bell (Grecian), cost £12,000: Hutcheson's hospital, founded about 1640, rebuilt 1803-5 by D. Hamilton, has a spire 150 ft. high, cost £4,800: the tower, 1663, of the old merchants' hospital or hall, Bridgegate, is 20 ft. square and 164 ft. high, surmounted by a ship in full sail as a weather-cock; the hall, rebuilt in Hutchinson-street, 1843 by Messrs. Clarke and Bell, cost £12,300: the trades' hall, 1791-9 by J. Adam (Italian) has a hall 70 ft. long and 35 ft. wide, cost £5,500; *RICHARDSON, New Vit. Brit.*, fol., London, 1802, i, pl. 8-9: and the sailors' home, Broomielaw, 1856 by J. T. Rochead (Italian), cost about £12,000.

The atheneum was formerly the assembly rooms, 1796-8 by J. Adam (the end pavilions 1807 by Holland), the hall 80 ft. long, 35 ft. wide, and 27 ft. high, cost £4,800: the Dunlop-street theatre, 1840, is by W. Spence: the Prince's theatre royal, 1848, is a building erected 1846 by J. Wyllson of London; details of construction, etc., in *BUILDER Journal*, vii, 74: the queen's rooms at the New Park by C. Wilson (Italian), cost £14,000: the Argyle arcade, 1828 by the late J. Baird, is 460 ft.

long and 16 ft. 9 ins. wide; the Wellington arcade, also by him, is 200 ft. long and 18 ft. wide; in 1861 it was enlarged by Messrs. Boucher and Cousland: the botanic garden, on the banks of the Kelvin, comprises about 22 acres; the curator's house and gate lodge are by C. Wilson: the observatory, 1840 by G. Murray (Tudor) is situated to the west of the city: the public baths, 1837 by J. Smith, cost £8,000: the abattoirs, by Messrs. Clarke and Bell, are good and very complete: the infantry barracks in Gallowgate 1795 cost £15,000. The railway stations possess no buildings for special notice.

Among the buildings occupied by societies are the Anderson's university, incorporated 9 June 1796, the lecture rooms and museum, 1828 by — Adam: the mechanics' institute, rebuilt 1861 by J. Salmon (Roman), cost £6,000: the surgeons' hall is being rearranged by T. Gildard: the corporation buildings and galleries, 1855 by J. Smith, cost £40,000, contain ancient and modern paintings: the procurator's hall and library, 1855 by C. Wilson (Italian, after the library of S. Mark's), cost £12,000: and the western clubhouse, 1840 by D. Hamilton (Italian), cost £20,000.

The national bank including the stock exchange, 1848-9, is by Messrs. Gibson and McDougall of London; COMPANION, etc., 1850, 240; CIVIL ENGINEER *Journal*, xii, 257: the union bank, 1841 by D. and J. Hamilton; the new telling room, 1853 by J. Salmon (Roman), cost £10,000: the British linen bank, 1839 is also by them: the royal bank by A. Elliot of London: the Western, now the Clydesdale, bank, 1840 by D. Hamilton (Venetian), was enlarged and much changed by D. Bryce: the city bank, 1858 by J. Black: the commercial bank, 1855 by D. Rhind; *Executed Examples of Eccles. and Dom. Structures*, fol., 1853: the bank of Scotland by W. Burn: the North British and Caledonian insurance offices, 1855 by Messrs. Clarke and Bell (Italian), cost £10,000 each.

The manufactories of Glasgow are extensive and exceedingly various, but it is only necessary to note amongst them the chemical works of S. Rollox, for the chimney stalk—Tennant's—out of many; it was erected in 1859, is 450 ft. in height, 50 ft. in diameter at the base, and 14 ft. at the top (CHIMNEY; BRICKWORK, p. 145), as well as that in Crawford-street, Port Dundas—Townshend's—erected 1859 by D. Macfarlane, which is 468 ft. high, 454 ft. from the surface of the ground to the top of the coping, 32 ft. diameter at the level of ground, and 20 ft. inside, and 12 ft. 8 ins. outside at the top of the coping; *BUILDER Journal*, xvii, 704; xviii, 174. Among the many warehouses which claim merit are the Exchange-square and Royal Bank-place buildings by D. Hamilton and J. Smith: Sir James Campbell's, Ingram and Brunswick-streets, the exterior 1854 by R. W. Billings of London (Scotch Baronial), cost £30,000; Royal Bank buildings by C. Wilson (Italian): Messrs. Black's, Renfield-street, 1858 by Messrs. Boucher and Cousland; *BUILDING NEWS Journal*, iv, 1225: Arthur and Co.'s, Miller-street, 1850 by J. Salmon: Middleton's, 1854 by J. Burnet, cost £18,000: Queen-street façade of Canada court (Lumsden's) by J. Wylson of London; who also designed Laidlaw's, Buchanan-street: Messrs. Anderson's, Miller-street, 1854 by A. Kirkland; Mr. Scott's, Bothwell-street, 1854 also by him: buildings in Trongate and Nelson-street by J. T. Rothead (the Scotch style): Madeira-court buildings, 1856 by J. Burnet, cost £35,000, and £22,000 for the site: Messrs. A. and S. Thomson's, Gordon-street, 1860 by Messrs. W. and G. Thomson (Grecian): Smith and Son's, Argyle-street, 1856 (Grecian), cost £13,000, by J. Baird; who also designed the following, viz. Prince of Wales's buildings, Buchanan-street, 1854 (Grecian); Macdonald's sewed muslin warehouses, Ingram, Hanover, and Queen-streets, 1854 (Italian), cost £90,000; and the Iron building, Jamaica-street, 1855 (Italian) of four stories in height, the front walls being of iron shafts, moldings and cornices, cost about £8,000: Messrs. Wylie and Lothead's, by — Lothead, contains a room 207 ft. long, 66 ft. wide, and 70 ft. high, cost £22,000: and Messrs. Walter Macfarlane and Co.'s

architectural and sanitary iron foundry, Washington-street, 1862 by Messrs. Boucher and Cousland (Venetian Gothic), cost £6,500.

There are but few illustrations of the buildings. Besides those mentioned in the text, Shawfield house by C. Campbell 1712, and now pulled down, is given in his *Vit. Brit.*, fol., London, 1717, ii, 51. MAITLAND CLUB, *Registrum Episcopatus Glasguensis*, edit. by Cosmo Innes, 4to., 1843; and *Burgh Records from 1573-81*, 4to., 1832; and from 1587-1750, 4to., 1836, edit. by J. Smith; M'URE, *View of the City*, 8vo., 1736, reprinted 1830; CLELAND, *Annals*, 8vo., 1816; and *Rise and Progress*, 8vo., 1820; PAGAN, *Gl. Past and Present*, 3 vols. 8vo., 1851-6; GIBSON, *History*, 8vo., 1777; DENHOLM, *History*, 8vo., 1797, and later editions; FORSYTH, *Beauties of Scotland*, 8vo., Edinb., 1805-8, iii, 185-326; A "Glasgow Delineated," 1826; the "Scottish Tourist," and the "New Statistical Account of Scotland," vol. vi, 8vo., 1845. A sketch of G., its *History and Progress*, is given in *BUILDER Journal*, xix, 889; xx, i, 69: and the *Transactions of the Architectural Institute of Scotland* contain some reports on the drainage of the town.

GLASS (Lat. *vitrum*; It. *vitro*; Sp. *vidrio*; Fr. *verre*; Ger. *glas*). This word, in the restricted sense in which the term is commonly used in the arts and manufactures as distinguished from its general acceptation among chemists, signifies a well known factitious substance, more or less transparent, produced by the igneous fusion of siliceous earth with certain alkaline earths or salts and metallic oxides. It is more or less colourless, but it may be stained by the application of metallic oxides. Thick pieces are hard and brittle; thin plates or threads flexible and elastic within certain limits; when struck it is sonorous; and heated to a red heat it becomes soft, ductile, and plastic. It is a nonconductor of electricity; but, while it resists the action of all acids except the fluoric, it is greatly affected by exposure to continuous moisture.

Though mention is made in writings of the earliest antiquity of transparent substances which have been understood by some to be glass, great doubts are now entertained whether an artificial product is meant by the terms used. It is not until the first century of the Christian era that any definite notice of the use of such glass for glazing and decorative purposes in buildings is found: to this application of it attention will be confined in the present article. ENAMEL; MOSAIC WORK.

The first mention of glass made among the Romans is under Tiberius, A.D. 14-37, when the manufacturers probably formed a company at Rome, to whom a street was assigned in the first region near the porta Capena. A tax was laid on them by Alexander Severus, 220, which subsisted in the time of Aurelian, 270-5, and probably long after; REES, *Cyclo.*: Aurelian, moreover, caused the cities of Alexandria and Memphis to pay a portion of their tribute in glass vases; BARTHÉLEMY, *Voy. en Italie*, 238. In the first century Caligula, 37-41, is stated to have new glazed the windows of his palace; GELL, *Pompeiana*, 4to., Lond., 1817-9, ii, 101. SENECA, *Quaest. Nat.*, lib. iii, vi, early in the first century, states that in his time the invention of window glass came into use. "Clear glass" and "transparent glass" are translations of the terms *βάλεφ καθαρόν* and *βάλεφ διαφανής*, employed by S. JOHN, in *Revelations*, xxi, 18, 21. Many glass utensils were found in the excavations at Herculaneum, destroyed 79; a flat piece of white glass, taken off near the extremity of the sheet, was also discovered; NIXON, in *PHIL. TRANS. ABR.*, 1757, xi, 86. At Pompeii in 1763, a window closed by a movable frame of wood which, though converted into charcoal held four panes about 6 ins. square, was found in a room of one of the baths. HAMILTON, in *ARCHÆOLOGIA*, 1775, iv, 171, records the finding of "fragments of large panes of glass in a villa". In 1824 a window 2 ft. 6 ins. high and 3 ft. wide, was found in another set of baths, the bronze panels of which held four panes fastened in by small nuts and screws, so as to be movable at pleasure.

Another opening, 2 ft. 8 ins. high and 3 ft. 8 ins. wide, was closed by a single pane two-fifths of an inch thick, ground on one side to prevent inspection, and fixed into the wall; many fragments were found in the ruins; Society for the Diffusion of Useful Knowledge, *Pompeii*, i, 155, 162; ii, 229. MAZOIS, *Ruines de Pompeii*, fol., Paris, 1814-35, iii, 77, gives the sizes of the panes in the bronze framed window; each being about 20 ins. broad by 28 ins. long, and the thickness more than two lines (5 to 6 millimètres). This glass has lately been examined by G. BONTEMPS, who, in a paper read before the Académie des Sciences, has described its tint as being of a greenish blue tinge like common French glass of fifty years since; the manner in which it was probably cast; and its component parts: a translation was given in the *BUILDING NEWS Journal*, 11 July 1862, 32; and in the *ATHENÆUM Journal*, Aug. 9 and 30, pp. 185, 284; the latter journal considers that some Roman glass was also blown, but it is not clear that window glass is meant by the writer. SMITH, *Dict.*, s. v. vitrum, states that thick sheets of glass of various colours appear to have been used for paving. PLINY, *H. N.*, xxxvi, 24, describing the theatre of Scæurus, notices that the second story of the scene was of glass: not the columns, as stated by some translators; who also differ as to the images of Augustus (67) whether they were of a dark coloured glass resembling obsidian, or of obsidian itself. His expression "vitreas cameras" (xxxvi, 64) has been supposed by some commentators to mean chambers lined with glass, but by others to refer to the windows only. According to GELL, *Pompeiana*; *Results*, etc., 4to., London, 1832, i, 99, a room so lined was discovered 1826 near Ficulnea in the Roman territory: he moreover states that, in the time of Seneca, the walls of the chambers in the thermæ were covered with glass and Thasian marble; and that the decorations were mirrors. A chamber lined with glass, partially tinged with colours, and having glazed windows, was found in the seventeenth century at Rome; NIXON, in *PHIL. TRANS.*, 1758, i, 601; 1762, lii, 123; and *PHIL. TRANS. ABB.*, xi, 233, 540.

In the third century Firmus, 273, was noted for the luxury of having glass windows, VOPISCUS, *Hist. Aug.*, i, 220, 422; while LACTANTIUS, *De Opif. Dei*, cap. viii, in the latter end of the century, is usually considered the first positive authority for the use of glass in windows; and also at the same period of glass and of LAPIS SPECULARIS. AGATE, ALABASTER, and other transparent stones, were at first employed to admit light and keep out the cold and wind: PHILOPONUS, 630, alludes to the use of thin skins like parchment; PLINY, xi, 45, states that the horns of the urus cut into thin laminae were transparent; TERTULLIAN, 135 or 160-220, writing less than two hundred years after PLINY, mentions the use of horn, *cornu speculare*; and PISCUS, on the authority of ULPIAN, ob. 228, states that a *vela*, made of hair-cloth or pieces of hides, was used before the invention of lapis specularis or of glass; NIXON, at sup.

In the excavations 1859 at Uriconium (Wroxeter) near Shrewsbury (destroyed circa 415), the most remarkable article connected with the structure of the houses was the window glass, which was found in considerable quantity, and appears to have been of good quality, though its transparency is now destroyed by the iridescence: its uniform thickness exceeds the eighth of an inch; BUILDER *Journal*, xvii, 372, 517. S. JEROME, A.D. 422, mentions windows formed of glass melted and cast into thin plates as used in his time: PAULUS SILENTIARIUS, a century later, notices its use at Constantinople, *Corp. Script. Hist. Byzant.*: GRÉGOIRE, bishop of Tours, fl. sixth century, relates in his history of the Franks, that in 525 a soldier entered a church by a window, the glass of which he had broken, DALLAWAY, *Obser.*, p. 529: FORTUNATUS, bishop of Poitiers, cir. end of the sixth century, in his work *De Situ Parisiensis Ecclesiae*, ii, 10, speaks of the rays of the sun passing through glass windows, HAWKINS, *Goth. Arch.*, 150. In the seventh century BEDE, *Lib. de Locis Sanctis*, c. 6, records that the light shone so brilliantly through the glass of a church on Mount Olivet near

Jerusalem, when illuminated, that the mount seemed on a blaze. JOHANNES PHILOPONUS, 630 or perhaps 530, states that glass was fastened into windows with plaster: S. Philibert had the windows of the abbey of Jumièges near Rouen decorated with glass; and though it appears to have been introduced into France in the sixth century, MURATORI, *Ant. Ital.*, ii, 392, notes that glazing was applied in Italy to church windows in the seventh and eighth centuries. In 687 many Greek workmen went to France for the purpose of working in glass; FILIASI, *Saggio sull' Antico Commercio*, etc., in *Memorie*, 8vo., Padua, 1811-4, p. 148 n. LEO OSTIENSIS, 760, describes windows in his time as made of glass plates fixed in lead and fastened together with iron. ANASTASIUS mentions that in the pontificate of Leo III, 795-816, painted glass in windows was in use: the coloured glass at S. Denis is of the date of 1150; that of Notre Dame at Paris is not so old, though it has been referred to the sixth century; and the statutes of the church of Tragaier in Lower Brittany, about 1156, notice the windows of the churches and chapels being ornamented with arms and military ensigns painted upon the glass in them; REES, *Encyc.* PAINTED GLASS; STAINED GLASS.

BEDE records that workers in glass were introduced into England in 674 by abbot Benedict Biscop, and employed in glazing the church and monastery at Wearmouth. Wilfred, bishop of York, who died 709, is said to have sent to France a few years earlier (669) for glass for his church, which had received light by means of the transparency of linen, or of boards pierced with many holes. At that time, and for many subsequent centuries, its use was confined to buildings appropriated to religious purposes, as a rare and costly article and a token of magnificence. Robert de Lindesey, monk and sacrist of Burgh, adorned above thirty of the windows of Peterborough cathedral with glass, which were previously filled in with straw to keep out the weather; he was abbot 1214-22; STEVENS, *History*, etc., *Additions to Mon.*, fol., 1722, i, 478. Horn and skins were in use down to the third and fourth centuries of the Christian era: wooden lattices, oiled paper, sheets of linen, and beryl, supplied the place of glass till the end of the twelfth century. Slit oyster shells are used to the present day, in India and China. The accounts of Rockingham castle, Northamptonshire, for 1279 contain the entry "For glazing the windows 5s."; *Mis. Rolls in the Queen's Remembrancer's office*, *ARCHÆOLOGICAL JOURNAL*, 8vo., London, 1845, i, 370. In the thirteenth century glass was first applied in domestic buildings, and was not common even in the fourteenth; TURNER and PARKER, *Dom. Arch.*, i, 73, iii, 121. A writ of 10 Richard II, 1386, was issued to collect the glass for a chapel, out of four named counties; RYMER, *Fœdera*, fol., 1709, vii, 527; or edit. 1740, iii, pt. iii, 205. Even so late as the sixteenth century, a glass window is mentioned as movable furniture; the lattice continued in meaner edifices even in the eighteenth.

In the fourteenth century, window glass was one of the many commodities obtained from the Flemings in exchange for English wool; some was also imported from Normandy, where the manufacture appears to have been of considerable antiquity; but it was most extensively produced in the Low Countries, in the district of the Vosges in Lorraine, and at Venice. Some other notices of its price and use at this period are given s. v. GLAZIER. The contract dated 23 June, 25 Henry VI, 1446-7, for glazing the windows of the Beauchamp chapel, Warwick, begun 1439, affords the earliest notice of the manufacture of window glass in England, but it also indicates that it was of inferior quality; DUGDALE, *Warwickshire*, fol., 1565, p. 329-54; 1730, p. 445; BRITTON, *Arch. Antiq.*, iv. English glass is also noticed in 1471 at York; s. v. GLAZIER. At some works done in London in 1485, Dutch, Normandy, and Venice glass are named, TURNER, i, 78; and in 1535, Normandy, Rhenish, and coloured Burgundy glass, were imported for windows; BROWNE, *York*, 271. The first English 'flint glass' was manu-

factured in 1552 at the Savoy House in the Strand, London: while works for the finer sort of window glass were settled at Crutched Friars, London, 1557, another glass factory was set up at Stourbridge, Worcestershire, in the same year, by a number of refugees from Lorraine, headed by a person named Henzole (now Ensell). One of the last of the "gentlemen glass makers" at Sir M. W. Ridley's works at Newcastle, was named Henzel; *Trans. Liverpool Arch. Soc.*, ii, 69. A patent was granted 8 Sept. 1567, 9th Elizabeth, to Antony Been, alias Dolyn or Dollyne, and John Care, Carye, or Carre, for making glass for glazing, "such as is made in France, Lorraine, and Burgundy", on condition of teaching the art to Englishmen and of paying certain customs to the crown; *Lansdowne MSS.*, lix, 72; *TURNER*, i, 76; this was renewed in October 1576 for twenty-one years, and the manufacture was prohibited by other persons, as well as the importation of it; *NOTES AND QUERIES*, vi, 323, from *BURN*, *For. Prot. Refugees*, 8vo., London, 1846, p. 253, who states that in 17 Elizabeth, 15 Dec. 1575, a privilege was granted to James Verselyn, a Venetian, for making Venice glass, and a glass house established at Greenwich is said to have soon blown finer metal than that obtained at Murano: this person is also mentioned by Stow, *STRYPE* edit. 1720, b. v, 240.

In 1580 fourteen (or 15) glass houses were at work in England, in which year George Longe petitioned for a patent for making glass, urging that he would have but two glass houses in England, the remainder in Ireland, where the forests were more extensive; *Lansdowne MSS.*, lix, 72; and lxvii, 25. While in 1580 a grant appears to have been prepared to enable Sir Jerome Bowes to erect furnaces to make drinking glasses, he does not appear to have received it until January 1591, when it was made for twelve years after the term of twenty-one years to James Vrselles or Verselyn should have expired. The *Lansdowne MS.*, lxvii, 162, notices in 1619, an English patent dated 8 James I, 1610-1, and a second one 19 January 1615-6, in an action against a Scotch patent which was alleged to be anterior to those; but no names are mentioned. In 1616, Sir Robert Maunsell, knight, vice-admiral of England, having obtained a patent for making window glass with stone coal, established works at Newcastle-on-Tyne (?), at Woolwich, and elsewhere; he is said to have erected the first house for that purpose in England (wood having been formerly used) at Newnham in Gloucestershire, *RUDDER, Gloucester*, fol. Ciren-
cester, 1779, 572; he obtained letters patent 22 May, 21 James I, 1623-4, for making glass (as excepted in 21 James I, c. 3); and in 1635 obtained workmen from Venice. Burgundy and Normandy glass, both coloured and white, with Rhenish and Muscovy glass, are alone named in the *Rates of Merchandizes*, 12 Car. II, c. 4, 1660. English glass was taxed for the first time by the act 6 and 7 William and Mary, c. 18, 1694, which besides mentioning 'plate glass', notices "all window glass or glass made in tables or otherwise proper to be used in glazed windows." This tax was repealed by 9 and 10 William III, c. 45. The first blown 'plate glass' for mirrors, coach windows, etc., is usually stated to have been made in 1673 at Lambeth by Venetian workmen, the chief of whom was named Rosetti, brought over 1670 by the second duke of Buckingham, or who set up works with his assistance; this manufacture was largely exported in 1714 (*STEELE, Lover*, No. 35, for May 13), and under the management of Dawson, Bowles, and Co., became powerful rivals of the French and the Venetian; *MANING* and *BRAY, Surrey*, 4to., London, 1841, iv, 468. The manufacture of glass blown in cylinders (to which the term 'window or table glass' is given), also of plate glass blown in cylinders, and cast plate glass, is described in the *UNIVERSAL MAGAZINE* for 1747, i, 152, 284: and 'crown glass' is stated in the *BUILDER'S DICT.*, 8vo., London, 1734, to be made by blowing glass in cylinders; and is also so described in other and important works: the method of making 'crown glass', as it is now called, by blowing a globe and 'flashing' it

open is not detailed; even the *ENCYCLOPÉDIE MÉTHODIQUE* describes sheet glass in the volume dated 1783, and crown glass in that of 1787.

Early in the eighteenth century, and for some time later, the places which furnished the English market with glass were Ratcliff (the works first established 1691 at the Bear Garden, Southwark); Lambeth; and Newcastle (? established 1728); all producing crown glass: Staffordshire glass was then not often used in London: Bristol glass was rare, but it was as cheap as and better than Newcastle: the manufacture at Woolwich was discontinued before 1736: in 1819, besides the Ratcliff and Lambeth glass, "that of Messrs. Hammond and Smith was the best of the three" in London: *NEVE*; and *REES*: the Newcastle being also greatly employed by name, down to about 1845. Plate glass for looking glasses was made at the Old Bear Garden, Southwark, and at Vauxhall. In the Act, again imposing a tax, 19 Geo. II, c. 12, 1745-6, "crown, plate, flint, or white glass" are named: that of 38 Geo. III, c. 33, 1797-8, has "any package containing plate glass, crown glass, or glass called sheet glass, which shall be imported"; while that of 43 George III, c. 69, 1802-3, has "plate or flint glass, enamel, stained or paste glass—spread window glass commonly called or known by the name of broad glass—all other window glass, not being spread glass, whether flashed or otherwise manufactured, and commonly called or known either by the name of crown glass or German sheet glass—and plate glass and all other glass manufactures imported". In 1773, a charter was granted to the Governor and Company of British Plate Glass Makers; their warehouse was situated in Upper Thames-street, near Blackfriars bridge, and their works at Ravenhead near Prescot, Lancashire, the latter are now the most capacious in Europe, *PELLATT*: in 1819 they made plates from 12 ins. to 144 ins. wide, and from 10 ins. to 72 ins. high, with convex and concave mirrors from 12 to 16 ins. diameter. Several other works were commenced in and about Newcastle-on-Tyne at the beginning of the present century; the Ravenhead *flint* glass works were started about 1820; and two other works at S. Helen's, Lancashire, in 1827.

From 1832 to 1838 great improvements were made in the manufacture of 'sheet glass' by Mr. Chance of West Bromwich, near Birmingham, and by Mr. Hartley (who subsequently set up works at Sunderland) with the cooperation of M. Bontemps of Paris, and though inferior in colour, the glass is in other points generally superior to that of the foreign manufacture; 'flatted crown' in slabs, and 'patent flattened sheet' were also then introduced. In Mr. Hartley's invention the metal is conveyed directly from the glass pot to a table, on which it is rolled into sheets without employing in each operation more glass than is necessary for each plate, however small; 'rough plate glass', thus obtained, is useful where translucency only is required. Mr. Chance's invention about 1840 of obtaining 'patent plate glass' from the thicker qualities of sheet glass, has proved a formidable rival to the old crown and sheet glass, and blown plate, for glazing purposes. The largest and finest known specimen of British plate glass was exhibited in 1851; it measured nearly 19 ft. in height and 10 ft. in width. The great impetus which has of late years been given to the manufacture of glass for domestic and building purposes, is due to the freedom of action arising from the abolition in 1845 of the excise duty. But the number of houses employed in the manufacture has diminished so much as to have led to something like a monopoly in the trade.

In Scotland there is a tradition that the glass for the cathedral at Dornoch 1222-45 was made near that place (*MORAY*); glass making, however, was introduced in the reign of James VI, who granted 1610 a right to manufacture it for thirty-one years to Lord George Hay; it was transferred 1627 to Thomas Robinson, merchant tailor in London, who again disposed of it to Sir R. Maunsell, before noticed. The first and very rude establishment was at Wemyss in Fifeshire; subsequently larger

works were erected at Leith and at Preston Pans; but all works for window purposes are now given up, as well as in Ireland, which country does not appear to have possessed any glass manufactories of a remote date.

As regards the manufacture of glass in foreign countries, the works at Venice appear to date from the thirteenth century. From Italy the manufacture was introduced into France, where an attempt was made in 1634 to rival Venice; but a more successful essay to make *blown* mirror glass was made by Colbert in 1665 at Tourlaville near Cherbourg (removed (?) to Auxerre in Burgundy, A. P. S.); about 1688 Abraham Thèvert invented *cast* plate glass and of a larger size; the manufactory was set up in Paris, but afterwards removed to S. Gobain in Picardy: the royal manufactory of S. Quirin (Vosges) founded 1730, eventually merged into that of Cirey near to it, which is now joined with that of Chauny and S. Gobain, as one company; the Montluçon company manufacture plate glass. In 1777 France had two sorts, white and common glass; the first, formerly obtained from Bohemia, was superseded by that made at S. Quirin, in plates measuring from 36 ins. by 30 ins. or 38 ins. by 28 ins., to 16 ins. by 10 ins. or 14 ins. by 10 ins., Fr.; the common glass, usually made in Normandy and supplied in tables 38 ins. to 44 ins. Fr. in diameter, was then rivalled by that from Alsace; BLONDEL, *Cours*, 8vo., Paris, 1771, vi, 451-5. A plate 20 ft. by 12 ft. is said to have been made in France about 1849 for the pacha of Egypt. One of the largest plates of glass in the International Exhibition of 1862 was made at S. Gobain; it measured 10 ft. 8 ins. wide by 16 ft. 6 ins. high.

The manufacture of window glass was introduced into America 1790: crown glass has been made in Boston since 1800, and in the vicinity of Pittsburgh are now nine manufactories of flint glass, and ten of window glass, and in the river towns there are fifteen window glass factories; ENCYC. BRIT. The following are the only other notes collected of the manufacture in other countries: it passed from Venice into Bohemia, which furnished glass of better quality than that of France, and of double thickness: Fürth in Bavaria yields window glass: the works on the river Neva near S. Petersburg have produced plates 8 ft. wide, 15 ft. high, and 14 ins. thick; and the clear cut glass windows of the Suleimanieh mosque at Constantinople, 1550-5, many of which are ornamented with flowers or letters, were from the manufactory of Serkhosch Ibrahim, celebrated at that period.

GLASS may be classified under the following subdivisions: *window glass*, including sheet, crown, and coloured, glass; *painted* and other kinds of ornamented window glass; *cast plate glass*; *bottle glass*; *glass for chemical and philosophical apparatus*; *flint glass* or *crystal*, with or without lead, white, coloured, and ornamented for table vases, etc.; and *optical glass*, flint and crown; (*Reports of the Juries*, 1851): also coloured glass for MOSAIC WORK; for ENAMEL; and as a GLAZE for ENCAUSTIC TILES, etc. Soluble glass will be noticed *s. v.* WATER GLASS. The doubtful assertion as to MALLEABLE GLASS will be noticed *s. v.*

Glass used for glazing purposes is of two sorts, blown and cast; they are treated specifically in this work, under the separate heads of SPREAD or BROAD GLASS, for common use (a manufacture now abandoned), blown in cylinders as sheet glass, but slightly conical in form: CROWN GLASS, blown into large globes and opened out into circular flat tables: SHEET GLASS, blown into long cylinders (or 'muffs', a term now nearly obsolete), cut and opened out into sheets of a square form and flattened; and PLATE GLASS, formerly blown in a cylinder like sheet glass, but now generally cast on iron tables, and used in the rough state for skylights and roofs; or ground and polished for windows, mirrors, etc. Thick blown sheet is also called plate glass, and is ground and polished. The 'crystal' sheet glass of the present English manufacture is very green in colour, though recommended for glazing engravings, as it does not *sweat*.

Glass as imported into England is distinguished as Foreign sheet; BELGIAN or GERMAN SHEET; FRENCH; CRYSTAL or Flint; and Bohemian, in sheets as well as for table use. Older varieties of manufacture were known as Lorraine; Venetian; Normandy; Rhenish, etc.

GLASS (OBSCURED, *i. e.* not clear or fully transparent) may be rendered more or less so by stain and colour, or paint; STAINED GLASS; PAINTED GLASS; STAINED AND PAINTED; POT METAL; FLASHED COLOUR GLASS; GRISAILLE. In other processes the desired effect is obtained by leaving the glass unpolished, as in Hartley's rolled rough plate, $\frac{1}{8}$ to $\frac{1}{4}$ in. thick: or by giving to it a roughened surface, as in GROUND GLASS, either by grinding with a stone; or by using fluoric acid, which process permits the application of ornamental devices (the pattern being obscured and the ground left transparent, or *vice versa*), and is called 'embossed glass'. This has been imitated in 'Bowden's corroded ornamental leaded window glass', and 'brilliant cut ornamental window glass'; in Baillie and Co.'s 'vitrified lace pattern glass'; and Hudson's 'embossed window glass', in which the plate is covered with a varnish, the lace, or net, or stencil pattern placed on, dusted over with a colouring matter in the state of fine powder, and then sufficiently heated to fix it on the glass: this process, which has been sometimes called 'matted work', was patented by C. R. Ayers, archt., 23 July 1842; CIVIL ENGINEER JOURNAL, vi, 281. Messrs. Chance sell various enamelled stencilled patterns as 'white enamelled', 'enamelled and flocked', 'embossed repeated pattern', 'stained enamelled', and 'double etched' glass, which are all variations of the 'lace pattern' glass above noticed. Their 'opal' plates for photographic purposes, of a cream like appearance, are also obscure. Molded, waved, jealous, or puzzle, glass is cast with flutes on one side, either rough or polished, and is 'plain', that is, with the fine marks of the casting table only; or has twelve flutes to the inch; or three flutes and a half to the inch—the former being also prepared as 'quarry glass'; or it is 'stained ornamented patent quarry rough plate', or 'patent diamond rough plate', glass—these all being examples of obscured glass as produced at Hartley's works. Other inventions are 'Rees's patent self-shadowed glass'; 'Burridge's patent polychromatic glass'; Powell's 'printed' on glass, and 'stamped in colours', etc. Joubert's method of producing photographs or other pictures in enamel colours on glass is one of the latest methods introduced, not only for windows, but for lamp shades and other ornamental purposes; SOCIETY OF ARTS JOURNAL, 22 May 1861; BUILDER JOURNAL, xix, 378. 'Etching on glass' is effected by the use of hydrofluoric acid in a similar manner to that on copper; Bedford has patented a process for this purpose, the design is painted with a peculiar composition, then fired, and dipped in a weak solution of nitric acid; KNAPP, 149.

GLASS, IN CONSTRUCTION AND DECORATION, was first so employed in conservatories and greenhouses, whence its application has become more fully developed, as in the International EXHIBITION BUILDINGS and crystal palaces. Glass roofs, or the smaller form, glass skylights, have enabled the architect to obtain accommodation and means for lighting works of art beyond those afforded by upright windows or side lights; and glass TILES and SLATES admit light in an inexpensive manner. Lockhead's perforated glass ventilator can either be set in the sash, or fixed outside of it for the whole width of the opening; air being admitted by pulling down the upper sash, when the perforated glass acts as a screen to the wind whilst permitting the access of fresh air to the room. Lloyd and Summerfield's columns of glass or crystal sash-bars are used in the exterior of shop fronts, with arched heads and spandrils of plate glass, having silver patterns on a coloured ground. The 'crystal fountain' of 1851, was 27 ft. in height. In 1852 it was stated that a column of glass placed on a pedestal of Carrara marble and surmounted by a statue of Peace 6 ft. high, by Rauch, was to be erected in the garden of the Peace

at Potsdam; the shaft to be ornamented with spiral lines of blue and white glass. Crystal balusters and handrails; pilasters for mantelpieces; centres for ceilings; mirror frames; curtain bars; door handles and plates; trays for dairies; candelabra; bells; cut crystal and opal letters; are among many of the minor uses of glass. Besides glass of all colours employed in MOSAIC WORK, and in ENAMEL work, a patent was taken out in 1851 for graining woods, veined marbles, or other decorations, on the back of glass, which was then embedded on any solid substance with a suitable cement. In addition to the common method of silvering glass for mirrors, Thomson's patent process of coating glass surfaces with a deposit of pure silver by the employment of saccharine solutions, and protected by a coat of cement, has been applied to many useful and ornamental purposes. About 1848 a French process was patented for lining damp walls with thin glass, on linen and gutta percha, called 'hydrofuge', but without success. A *glass cask* is also a French invention; glass pipes for the conveyance of aqueous or æri-form fluids, with Mayo's patent joints (patent 21 Aug. 1850), may be laid down by any ordinary workman; PRACTICAL MECHANICS' Journal, iii, 180. The Resistance of Glass Globes and Cylinders to Collapse from External Pressure, was the title of some remarks by W. Fairbairn and T. Tate in 1859; together with others on the Tensile and Compressive Strength of various kinds of glass; PHIL. TRANS.; and BUILDER Journal, xvii, 486, 864.

GLASS (DECAY OF). It is stated that the old stained glass of the windows in the north transept of York cathedral is about a quarter of an inch in thickness, but time has perforated it, in semblance to honeycomb, and in some instances reduced it as thin as paper; BROWNE, *York. Cath.*, 88. The windows of Thornhill church, Yorkshire, it is said, are free, "for some reason or other, from that peculiar species of corrosion to which ancient painted glass is subject;—long continued damp produces a diminutive moss or lichen, which absolutely decomposes the substance of the glass in vermicular lines; this evil would be greatly prevented by wiping it away annually. It is remarkable that this disease prevails in some situations more than in others. I have specimens of painted glass, which had stood unimpaired in a dry situation for centuries, so injured by being removed into a moist and foggy atmosphere, as to have almost lost all their beauty in thirty years"; WHITAKER, *History of Leeds* (Loidis and Elmete), fol., Leeds, 1816, 322. "The glass [found at S. Stephen's chapel, Westminster] was of unequal thickness, a piece was frequently at one part near a quarter of an inch, and in another not a sixteenth of an inch; and many of the pieces were much corroded. Corrosion of glass in situations near the sea is not uncommon, and is owing to the particles of alkaline salt with which the air in those places is so strongly impregnated: the same effect has been also observed in situations distant from the sea. Whenever alkaline salt is employed to a greater extent than ordinary, the corrosion of the glass had been complained of; and in the instance of wine bottles in particular, it had often happened that the bottles had been by this circumstance rendered leaky, and the wine had run out. VAN HELMONT has remarked that if a piece of glass be covered with a liquid alkali, and exposed in a damp place, the whole piece will be dissolved into water; NERI, *De Arte Vetraria*, 18mo., Amst., 1686, 234ⁿ; SMITH, *Antiq.*, 4to., 1807, 234. If potash or soda be the substance combined with the silicic acid or silica used in the manufacture, without any third ingredient, a glass is produced which, though presenting the usual vitreous aspect, is easily dissolved in water.

Besides what has been stated in the articles DEVITRIFICATION and ATMOSPHERIC INFLUENCE, it is to be noted that air and light operate upon white glass, probably, by their oxidizing properties. Bluish or greenish coloured glass becomes colourless in consequence undoubtedly of the peroxidization of the iron, to whose protoxide it owed the tint. "With an admixture of carbon, Bohemian glass assumes a beautiful yellow colour;

when it is present in somewhat greater quantity, the glass assumes a purple red colour. Peroxide of manganese opposes also this discolouration of glass by carbon, an accident which frequently happens when the furnace has no proper draught; a small quantity of nitrate of potassa will also prevent it"; REGNAULT, by BETTON, i, 623. Other glass becomes purple red from the peroxidization of the manganese: this is said to be the characteristic of true old Venetian glass. In glass containing lead, if sulphuretted hydrogen be in the air, the oxide of lead is converted into a sulphuret, rendering the surface of the glass opaque and iridescent; the more lead, the quicker this iridescence supervenes. Ancient glass becomes iridescent, and then scales off; an attempt to fabricate antiques has been made at Naples, by fixing the scales of old Roman on modern glass. Good glass will remain smooth and transparent; bad glass will become rough and dim. The brittleness of unannealed glass by change of temperature is sometimes very great, URE, *Dict.*: when not sufficiently annealed, it breaks under the diamond instead of cutting sharp and clean. Annealing also affects the colour: the amount of change depending on the nature of the fuel and the length of time the glass is exposed to it. Glass of a purple tint becomes colourless during annealing; if the process be too long continued, it changes to green; and if apparently colourless before annealing, it is subsequently tinged with green: previously to annealing it is more brilliant than after, thus great care is required in regulating the process.

A kind of roughness irremediably clouding the transparency of a certain kind of glass, especially of some formerly made in Oxfordshire, where it was called 'crizzelling', appeared to arise from the too great proportion of the nitre, tartar and borax in its composition, being probably acted upon by the atmosphere; PIOT, *Oxfordshire*, 258. Glass containing manganese often becomes very dark; a tint of greenish yellow is least liable to alteration; all whiter or yellower tints are liable to alteration for the worse: a light blue changes for the better, some varieties becoming colourless by a few years exposure; this tint, however, causes great objections to its use, as it gives a cold appearance to objects seen through it; *Transactions*, Liverpool Arch. Society, read 19 February 1851.

GLASS HOUSE or GLASS WORKS. The place where glass is made, is usually built in the form of a cone from 60 to 100 ft. high, and from 50 to 80 ft. in diameter at the base. The furnace is constructed in the centre of the area, several minor furnaces being placed around or adjoining it. The manufacture of *crown glass* requires a *calcar arch* for calcining the FRIT; a main or glass making furnace; a blowing furnace; a flashing furnace; and a *leat* or annealing oven or kiln: that of *sheet glass* requires a *calcar arch*; a main furnace; a blowing furnace; a swing trough; a flattening kiln; and an annealing oven. The glass house (Fr. *la halle*, the cone not being used) for *plate glass* requires a melting furnace; a casting table of iron; with annealing ovens (Fr. *carquaises*) on each side of the *halle*, that at Ravenhead is 339 ft. long by 155 ft. wide; that at S. Gobain in France is 174 ft. by 120 ft. These are all irrespective of shops and sheds for subsidiary purposes, with warehouses, etc., for stowage. Observations with Wedgwood's Pyrometer have shewn the proper temperature for working to be 70°; APPLETON. The prevailing temperature of a glass furnace is 12,000° C.; KNAPP.

The earliest publication on the subject of glass appears to be that of AGRICOLA, *De re Metallica*, 8vo., Paris, 1541 (1657 is on some titlepages); copied by NERI, *L'Arte Vetraria*, 4to., Florence, 1612; translated by MERRETT, *The Art of Glass*, 12mo., London, 1662; also by BLANCOURT, *De l'art de la Ferrerie*, 8vo., Paris, 1697 (1667, *Trans.*, Liverpool Arch. Soc.); translated into English, *Art of Glass*, 8vo., London, 1699; and partly reprinted in PRACTICAL MECHANICS' Journal, 1848, i, 126-8: BASTENAIRE DAUDENART, *Art de la vitrification*, 8vo., Paris, 1825; REGNAULT, *Cours élémentaire de Chimie*, 12mo., Paris, 1849-50, art. Verre, ii, 332-66; and

transl. by BETTON, 8vo., Philadelphia, 1852, i, 263; BOUDET, *Notice hist. de l'art de Verrerie*, in *Descr. de l'Egypte*, 1829, ix, 213-59; THIBAUD, *Notice hist. sur les Vitraux anc. et mod.*, 8vo., Clermont, 1842.

PELLATT, *Curiosities of Glass Making*, 8vo., London, 1849; PORTER, *Porcelain and Glass*, in LARDNER'S *Cyclopædia*, 8vo., 1832; REES, *Cyclopædia*, 4to., London, 1819; *ENCYCLOPÆDIA BRITANNICA*, 8th edit., 1859, with illustrations, s. v.; Liverpool Architectural Society, *Transactions*, ii, 67-82, 4to., 1855; Society of Arts Journal, 1856, iv, 222-8, paper read by CHANCE, reprinted in *BUILDER Journal*, xiv, 139, 185, 205; also by SHAW, at the same Society 1852, and printed, 8vo., London, 1852; Royal Inst. Brit. Archts. *Transactions*, 1849-50, paper by DONALDSON; DALY, *Revue Générale*, xii, 194-219, and 241-256; *Reports of the Juries*, 1851, 521, etc.; *BUILDER Journal*, ix, 224; xii, 189; xvii, 642; xix, 377; KNAPP, *Chemistry applied to the Arts*, edit. by RONALDS and RICHARDSON, 8vo., London, 1848, ii, 1-150; APPLETON, *Dict. of Mechanics*, 8vo., New York, 1852, i, 863; MERRIFIELD, *Art of Painting*, 8vo., London, 1849.

W. P.

GLASS CEMENT. A medium used to unite pieces of glass, china, etc. The 'diamond cement' is composed of isinglass dissolved in proof spirit, to which gum resin and resin mastic are added. White of egg alone, or mixed with quick lime, will make a joint if it be not exposed to moisture. Silicate of potash will unite stone with glass. A transparent cement is formed of caoutchouc dissolved in chloroform. A cement for aquariums is made of pitch and caoutchouc. *BUILDER Journal*, xv, 443; xviii, 631.

GLASS CLOTH. Coarse calico coated with powdered glass, china, etc. The 'diamond cement' is composed of isinglass dissolved in proof spirit, to which gum resin and resin mastic are added. White of egg alone, or mixed with quick lime, will make a joint if it be not exposed to moisture. Silicate of potash will unite stone with glass. A transparent cement is formed of caoutchouc dissolved in chloroform. A cement for aquariums is made of pitch and caoutchouc. *BUILDER Journal*, xv, 443; xviii, 631.

A. A.

GLASS PAPER. Paper coated on one side with glass crushed under an edge runner, and used by joiners and cabinet makers to rub down work where a particularly smooth surface is required; its use leads the workman to neglect the proper finishing of his work with the regular tools, being thus susceptible of great abuse in practice. The paper first receives a coat of thin glue, sometimes tinted with Venetian red, over which the powdered glass is sprinkled from a sieve. The following varieties are made, distinguished by numbers, as 0, 1, 1½, 2 fine, 2 middling, 2 strong, 2½ coarse, and 3 very coarse. Joiners' work was formerly rubbed down with a coarse broad leaved sedge called 'shave grass', and also by shark's skin. These, however, have been superseded by glass paper, which itself is fast giving way to GLASS CLOTH. *Sand paper*, made of common sharp house sand of one degree of coarseness, is often used instead of glass or even calcined flint, for similar purposes; its effects on metals is between glass paper and emery paper.

A. A.

Emery paper is prepared in a similar manner. There are about six degrees of coarseness; sieves with thirty and ninety meshes per lineal inch are in general the coarsest and finest sizes employed. When used by artizans, the emery paper is commonly wrapped around a file or a slip of wood, and applied first like a file, with or without oil according to circumstances; the emery paper cuts more smoothly with oil, but leaves the work dull. *Emery cloth* is also made. Smiths, engineers, etc., prefer the paper; but where the hand alone is used, the greater durability of the cloth is advantageous; *URE, Dict.*, 4th edit., 1853.

GLAZE. A vitreous surface fixed upon articles made of clay. The application of a glaze on the surface constitutes a very important feature in the process of the ceramic art; and it must be remembered that glazed stoneware is not glazed earthenware, although objects such as drain pipes are sometimes made in the latter instead of the former material. When the material of stoneware pipes for drains is heated to a white

ARCH. PUB. SOC.

heat in the kiln or oven, salt is added, and its fumes act chemically upon the surface of the ware to such an extent that they fuse the particles into a kind of glass: in like manner the *jasper* of Wedgwood has a surface like that of a gem because the body is made of vitrescent materials. All other glazes are compositions applied after the ware has been baked for the first time, *i. e.* while it is in the state called *biscuit* by the potter; and they may be either transparent or opaque, clear or coloured. All painting in oil (printing) and in water is done before any transparent glaze is applied; but the glaze is baked before enamel painting or gilding is added. Black, brown, red-brown, pink, lilac, blue, green, and orange, are the colours produced on a white body by the painter in oil or in water; and red, rose, yellow, and white may be added to the list as easily obtainable by the painter in enamel, who is also supplied with other colours and tints by those who prepare pigments for him. The flux for enamel is commonly a combination of red-lead, borax, and flint, while the materials of common glaze are at present white-lead, Cornish granite, flint, and flint glass; formerly a stanniferous glaze was used, consisting of oxide of lead, oxide of tin, and a white earth. The latter is the 'lead glaze' mentioned *s. v.* ENAMEL, etc., TILES; the modern or encaustic tiles receiving a common glaze. The use of glazed bricks, which was a novelty in Paris when Jacques Cœur built 1436-51 his house in the rue de l'Homme Armé (they had lost much of their lead or copper glaze in the time of SAUVAL, *Histoire*, fol., Paris, 1724, ii, 258-9), had expired, and the manufacture had not been renewed until within the last ten years, when enamelled bricks decorated with printed or painted patterns, which are nothing more than common bricks faced with enamel, have been again manufactured by a process which reproduces the 'terra invetriata' of Luca della Robbia. The use of glazed bricks has been lately so much pressed upon the attention of the architect, that it is worth while to mention the difficulties which at present render their employment too expensive. In the case of self-coloured glazed bricks, the manufacturer has first to find either a clay with mineral matter present to give the required tint, or to find one free from mineral matter and to tint it, or to find a clay to which he can add a mineral that will combine with the mineral matter already present. When he has procured the clay of the tint required, the glaze (appropriately clear or coloured) must be added: such self-coloured glazed bricks should be less expensive than bricks with a plain enamel; *BUILDER Journal*, 1855, xiii, 107. CERAMICS; POTTERY.

GLAZIER. An artisan, whose business consists in fitting glass in sashes, frames, and casements, either in putty or in lead: these works may be classed under the heads of SASHWORK and LEADWORK; *fretwork* being the ornamental portion of the latter. Putting glass into a new sash, etc., is called 'glazing'; while reglazing a sash, etc., is called 'stopping'. The tools (which the glazier has to find) required for sashwork, are a diamond for cutting the glass; a lath or rule for guiding the diamond (the *ranging* of glass is the cutting it in breadths); a short lath for stripping the square to make it fit the rebate; a square for obtaining accurate return sides; a *glazing knife* for laying in the putty on the rebates, for bedding the glass, and finishing the front putty; a *bradding hammer*; brass points for fixing large panes; small cut brads or sprigs; PUTTY, in which the glass is bedded; a duster or large brush for brushing the putties and removing the oil from the glass; a *sash tool*, used wet, for taking the oil from the inside after the back putties are cleared off; a *hacking knife* for cleaning out the old putty from the rebates in which squares are to be stopped; and a rule of peculiar construction for measuring.

For the second, or leadwork, besides some of the tools already noticed, the glazier requires a *vice*, for drawing the lead slips formerly called 'caums, calves, or bands', with grooves or 'riggets', etc., after it has been cast, to receive the glass; a *setting board* or 'cleaving board', on which the ridge of the

light is worked, and divided into squares, and struck out with a chalk line, or drawn with a lath, which serves to guide the workman; a *latterkin* or *laperkin*, a piece of hard wood pointed, to clear the groove of the lead, and widen it in order more readily to receive the glass; a *setting knife* for cutting the lead and for forcing the squares home in it (a tool is also used having a 'working' or 'stopping' knife at one end with a nipper at the other, and called a knife and 'grosing iron' in one); a *soldering iron* for melting the *solder* when making a joint; *resin* for laying on the joints of the lead before soldering; a *tile stone* to rub the iron to make it take up the resin; clips or bands for holding the lights to the iron bars; and an *oil* or *simoning brush* (by some called a *rubber*) to apply a mixture of burnt alabaster and oil to the leadwork, used to keep out the air. The third, or fretwork, as already noticed, is the ornamental part of lead light work, forming the glass into devices and patterns: the same tools are used as for leadwork. 1.

In London a large portion of the glazier's business consists in cleaning windows. To do this properly, especially where the top sashes will not draw down, or the upper lights are fixed, a machine called a glazier's horse is employed, which is so contrived that the cleaner can stand outside the window, and reach the parts requiring cleaning.

It has been noted by TURNER, i, 76, that among the witnesses to numerous existing deeds and conveyances of property in the thirteenth and fourteenth centuries, a glass maker does not occur, and a glazier but rarely; he mentions a *vitrearius*, temp. Henry III, 1216-72. In the *Memoriale* of Henry prior of Canterbury, written early in the fourteenth century (Cotton MS. Galba, E. IV, fol. 28 b), occurs *Of the weight and measure of glass*, one hundred pounds of white glass cost 8s., the great hundred contains twenty-four poise; of one poise of glass, which contains five small pounds, may be made one glass window two feet and a half long and one foot wide. That is, of two small pounds and a half of glass may be made one foot and a quarter of a glass window in length and width. And the foot is worth 2d. without the wages of the glazier. To every poise of glass there should be had two small pounds of lead—that is, to every foot of a glass window one small pound of lead mixed with tin." BRITTON, *Exeter*, fol., London, 1836, p. 95; SMITH, *Antiq. of Westm.*, 4to., London, 1807; BRITTON and BRAYLEY, *Palace of Westm.*, 8vo., London, 1837; BENTHAM, *Ely Cath.*, supp., 4to., 1817, p. 65; BROWNE, *York Cath.*, 4to., York, 1838-47, pp. 124, 203, 251-2, and SURTEES SOCIETY, *Fabrick Rolls of York*, 8vo., 1859, p. 76, etc., give numerous notices of the glazier during the fourteenth century; at which period a seam of white glass cost 7s. 3d., and 11s. 6d.; a pannel of white glass 22d.; and 100 pondera of the same cost 16s. per hundred of 124 pondera, each pondera being 5 lbs. In 1471 at York a wisp of glass cost 10d.; one of ruby glass 16d.; a seam of English glass £1:6:4; a wave of glass £1:13:4; the glazier being paid 3s. per week, the master glazier 3s. 4d. In 1567-76, the English makers were to pay 12d. for every case of glass of the fashion of Normandy containing 24 tables = 120 ft.; 15d. for every case of Lorraine or Burgundy fashion containing 20 bundles = 10 ft. each; and 3s. 1d. for the waye of Hessen glass containing 60 bundles; and to charge 32s. at most, 21d. each bundle, and £3 the waye, respectively; BURN, 254. In 1602 a quarrel of glass cost 1d.; new leading a casement 8d.; new glass in the stables ½d. per foot. In 1641, and for about twenty years previously, Maunsell sold his English made glass for 22s. 6d. per case of 180 ft. "at the furnace door"; before that period, the case varied 120, 140, and never above 160 ft. In 1660 Burgundy glass was imported by the chest of 24 tables; Normandy by the case of 24 tables; Rhenish by the weigh or webb of 60 bunches; and Muscovy glass or slude by the pound. In 1688 a load of glass was equal to two kribbs, one kribb being equal to 100 or 150 ft. of cut glass; a case contained 16 bunches of broad glass, and one bunch was three tables, a table being a broad piece nearly a yard. QUARRY.

The glazier and his boy were under the sacrist's office at Canterbury; SOMNER, *Hist.*, 4to., London, edit. 1703, i, 95.

GLASS CUTTING. After crown glass is annealed it is cut into two unequal pieces at the works, a little on one side of the knot. The larger is called the *table*, the smaller, the *slab*. It is then packed into crates and sold to the *glass cutter*, who takes out the glass and proceeds to range or cut it into breadths, by lightly running the diamond across it and then tapping the glass under the margin or 'selvage' till a crack is seen through, then dexterously placing his hands on each side the cut, thumbs uppermost, causes the crack to run along the line made by the diamond. It is then cross cut into lengths and delivered to the glazier. A very ingenious machine is used for cutting circles out of glass. Cutting glass with the *diamond* (EMROD or emry) was probably known in the East at a remote period, but its introduction for dividing plain surfaces is supposed to date from the sixteenth century; MERRIFIELD suggests it was known at least a century earlier, and refers to VASARI for the use of the emerald for the same purpose. Glass is said to have been formerly cut with a pair of shears under water; with a sharp pointed instrument of the hardest steel; or a piece of red hot charcoal. Some of the facets on the minute crystals of a piece of railway coke will answer the same purpose. During the operations of glass making, the glass is often divided by an iron chisel dipped in cold water run along the hot glass to be separated; or the cylinders are split by a red hot iron, especially those of FLASHED or 'cased' glass, i. e. sheet glass having one side covered with a skin of coloured glass. The diamonds used are the 'pencil' point, and the 'plough', the former for crown glass, the latter for plate glass, the last named has a deeper 'spark', as the diamond is called, than the former, a deeper cut being required for plate, than for crown, glass. The diamond will only cut glass with its natural angle, an artificially made angle only scratches, and produces such marks as are made by a diamond set in a ring; the setting, therefore, of a diamond in its handle, and the holding of it while cutting, require great nicety and practice.

Crown glass is said to cut best in a warm atmosphere, and when it happens to be *hard*, it is occasionally heated before being cut into breadths, etc., as above noticed; the cutting to good advantage requires skilful calculation to prevent waste: COOPER, *Crown Glass Cutter and Glazier's Manual*, 8vo., 1835. Thick glass may be cut by an ordinary mason's chisel, or sawn by the common plane edge saw used for sawing marble; a copper saw answers best, a finer description of sand being used with it. The edges of a slab 5 ft. wide, 4 ft. long, and 1½ ins. thick, can be so prepared by the chisel in about four hours, that they will make the finest possible joint with stone paving; C. H. SMITH, *Transactions of the Royal Inst. Brit. Architects*, 1849-50. A steel drill, hardened and used without drawing the temper, will, if the point be kept wet, drill ordinary glass; window glass offers greater resistance to drilling than that which is thicker. In boring glass it will be found advantageous to moisten the points of the steel instruments, drills, etc., with a little oil of turpentine in which some camphor has been dissolved; holes of any size can then be easily bored; KNAPP, 150.

As glass expands by heat, provision must be made to prevent injury from this expansion, as also from that arising from the expansion of metal bars, by cutting the pane less than the full width between the rebates, according to the size of the glass: DILATATION, however slight it may be, is irresistible, and cracks ensue. In some very large plate glass windows, especially where the sashes are of metal, it is the practice to insert thin slips of wood between the side edges of the glass and the rebates of the bars; flannel is also used, but is subject to decay; indiarubber or mackintosh cloth is best for large squares; the glass being secured by slips of wood screwed into the back of the sash bars. Nixon, of Kettering, has devised a method of glazing without putty, consisting in the use of zinc

bars hollowed to receive the glass and to carry off condensation and rain. It may be of service to mention that glass may be removed from sashes without the use of the hacking knife, which when the putty is very hard injures the bars. A mixture of three parts of American potash and one of unslaked lime, laid on with a stick on the old putty on both sides of the glass, and allowed to remain for twenty-four hours, will render it soft enough to cut out easily.

GLENDALOGH, in Ireland, see GLANDELAGH.

GLENK (JOHANN GEORG), born 1751 at Hall in Swabia, studied at Berlin and Dresden, became bau-inspektor at Hall, 1783 designed the inner building at schloss Ochringen, and was baurath at Hohenlohe-Ingelfing. He died in 1802. The same post was attained by his brother and pupil. 68.

GLENK (JOHANN WILHELM), born 1753, built the Gesundbrunnen at Hesselbrunn, finished the stiftskirche at Hechingen, restored the fortress at Hohenzollern, was much employed on bridges and roads, and died in 1810. 68.

GLEVUM. The Roman name of GLOUCESTER in England.

GLOBE. The solar globe or disk, usually coloured red, from the front or sides of which issues the ureus asp, is the usual mark of the god Ra (*Helios*, the physical sun), the wings of whose emblem, the hawk, are frequently placed on Egyptian temples, e.g. in the bold cavetto molding of the cornice over a doorway. The resemblance of the winged globe found at Palenque, copied from STEPHENS, *Incidents*, 8vo., London, 1841, ii, 259, in the *CIVIL ENGINEER Journal*, 1850, xiii, 74, to the Egyptian symbol, has been considered too exact to have been accidental, and is therefore one of the proofs adduced by those who assert that the Gulf States of South America were populated by colonists from the Indian seas, as well as by those who consider that the predecessors of the sculptors at Palenque derived their knowledge from others living on the shores of the Mediterranean. The globe is often employed in decoration as a symbol of sovereignty, as the orb with the sceptre in the regalia of the English monarchs.

CROWN GLASS is blown into a globular form before it is 'flashed' open. The resistance of glass globes, etc., to pressure, is noticed *s. v.* GLASS. Champagne bottles will often withstand a pressure of forty atmospheres and upwards, that is 600 lbs. on the square inch; APPLETON, *Dict.*, 8vo., New York, 1852, i, 868.

GLORIA (GIOVANNI) was in practice 1756 at Padua, where he designed the cupola of the cathedral; he erected there the church of Sta. Rosa, which MILIZIA, ii, 370, considers a remarkable (Palladian) edifice; and the teatro nuovo, opened 1751. 68.

GLORY. This word not only expresses the meaning of the Latin *aureola* and *nimbus*, but also the mass of rays frequently seen in churches on the continent, which serve as a background to a crucifix. The various forms of the *nimbus* or conventional indication of a glory surrounding a single head, as well as of the *aureola* or representation of a glory, including the so-called *vesica piscis*, around a figure or a group, are described in OUDIN, *Manuel*, 8vo., Paris, 1845, p. 322.

GLOTHAU (HANS), master of the mint at Danzig, is considered to have been the designer 1487-94 of the Schiessgartenhall in that city. 92.

GLOUCESTER (the Roman GLEVUM). A city and county in itself, situate in the county of Gloucester in England. Many tessellated pavements and architectural fragments, ascribed to the first century of the Christian era, have been discovered in various parts, at depths varying from 7 ft. to 10 ft. below the general level of the ground; in the hamlet of Kingsholm, Wotton, and other environs, pottery, coins, skeletons, and other remains have been found. It is built on the east bank of the eastern branch of the river Severn, which is here divided into two channels crossed by two bridges, connected by a raised road across Alney island called Over causeway, which is about half a mile in length. Over bridge, built 1826-8 by T. Telford,

of one arch, of Forest of Dean stone, is 150 ft. span, 25 ft. wide, and 35 ft. rise, presenting the combination of an ellipse with a segment of a circle gradually worked into each other, the spandrills produced thereby being bevelled to form a groin shape from the abutment to the centre; the key stone is 4 ft. 6 ins. thick: Westgate bridge 1814-16 by Sir R. Smirke, R.A., has one arch 87 ft. span, 28 ft. 7 ins. above low water, and 40 ft. wide. The city consists of four principal streets crossing each other at right angles inclining to the four cardinal points of the compass, and a number of smaller ones, all tolerably straight, but the latter confined; some contain the remains of domestic edifices dating late in the mediæval period. Of the old Ram inn, Northgate-street, nothing remains but the entrance archway, on which is an inscription in mediæval characters "Behold the once ruinous house which John Osborne, commonly called the town monk, rebuilt": the New inn, Northgate-street, erected 1450-7 by John Twining, a monk, for the accommodation of pilgrims, is of timber lathed and plastered; it is of considerable extent, forming two square courts with external stairs and galleries leading to sleeping apartments; a subterranean passage, now blocked up at each end, formerly communicated with the abbey: the Booth hall in Westgate-street, the ancient guildhall, was subsequently converted into an assize court; the hall, rebuilt in 1606, is spacious and lofty, and supported by double rows of wooden pillars. The town walls were destroyed 1662, and the gates 1749 and 1809: the High Cross was removed 1749, with several other crosses in various parts of the city.

The modern houses are substantially built of brick and stone; the streets are well paved, and since 1819 lighted with gas: water was supplied from the reign of Charles II by works situate at Robinswood-hill, two miles distant; these were enlarged in 1830, and have lately been united with more extensive works at Witcombe, at the base of the Birdlip hills, five miles distant, where large impounding reservoirs are formed at a level to give sufficient head to supply all parts of the city; these works were designed by J. F. Bateman, C.E., and opened in 1860. An efficient system of sewerage, designed by T. R. Rammell, C.E., having its outfall into the river Severn, has been introduced in all parts of the city.

The Gloucester and Berkeley ship canal, of which the late R. Mylne was engineer, was opened in 1827; it is seventeen miles long, from 70 to 90 ft. wide at the top, and from 20 to 40 ft. at bottom; the depth 18 ft., admits vessels from seven hundred to eight hundred tons burden; one level is maintained from Gloucester to Sharpness; there are locks at each end to connect it with the river Severn; a large basin or dock at Gloucester nearly eight acres in extent, has extensive warehouses on three sides; and a smaller one at Sharpness, receives vessels waiting for ingress or egress; the cost was about £500,000; Forest of Dean stone and Hampton Common stone were used in the construction of the walls of the basins, locks, and bridges. The Hereford and Gloucester canal, issuing out of the western arm of the river, is about thirty miles long.

A bishopric existed from 490 to about 570; again 1541; joined with Worcester for a few years; again separated 1553; united to Bristol in 1562; divided in 1589; and again joined to Bristol in 1837. The prior was made abbot in 1104. The Benedictine abbey of S. Peter, founded 672 and finished 682, was rebuilt 1058, burnt 1088, the first stone of the new building laid 1089 by Robert bishop of Hereford for abbot Serlo, consecrated 1100, damaged by fire 1101, 1122, 1179, and 1190, and from lightning in 1214 and 1223. The church presents the general character of a Norman cathedral, but has been subjected to alterations and adaptations of the old to the later work, by the cutting out from the earlier and by various insertions and conversions, and the re-use of the old masonry. In 1242 the vault of the nave was completed by the monks themselves; 1307-29 the clearstory and roof to the nave and south transept were built; 1307-18 the present external façade of

the south aisle was built and the roof was regroined (this façade is a simple casing of the Norman wall, with the addition of strong detached buttresses, decorated with the ball flower, which is also introduced in the intervening windows): 1337-51 the groined vault and clearstory of the choir were built, and the Norman work cased internally, these are supposed to have been designed by John Boyfield, a monk, who was supervisor of the work, and afterwards abbot, and who added the thirty-one stalls on the prior's side; 1330-75 the thirty-one stalls on the abbot's side were added, and the aisle of S. Paul, or north aisle, and north and south transepts were built; and in 1351-77 the high altar and presbytery. In 1351 also was commenced, perhaps from Boyfield's design, who died 1381, the great north cloister as far as the door of the chapter house; it is 148 ft. from north to south, and 144 ft. from east to west, 14 ft. wide, and 16 ft. 6 ins. high; it was completed 1412; on the north side of the south walk are twenty carrels or seats which are supposed to have been used by the monks while transcribing; in the north walk is the lavatory with a recess opposite for the towels; the groined roof is one of the first and best instances of fan tracery; DALLAWAY, 190; and Professor WILLIS. In 1420-37 the west front, the two west pillars of the nave, and the beautiful south porch were erected; 1450 the choir was paved with encaustic tiles, some of which remain; CARTER, *Ancient Sculpture*, fol., London, 1780; NICHOLS, *Enc. Tiles*, 4to., London, 1842-5. The elaborate central tower was commenced about 1456 by abbot Seabroke, who dying in 1457 committed the supervision of its completion to Robert Tulley, a monk, afterwards bishop of S. David's; DALLAWAY, *Discourses*, 8vo., London, 1833, 178, relates the tradition that John Gower was the master mason (BRITTON, p. 72, however, says he completed the choir), of whom the curious projecting "mason's square" in the east wall of the south transept is presumed to be commemorative; it is given in CARTER. In 1457-98 was built the Lady chapel, "the lower portion of the walls nearest the east window of the choir is a part of one of the old chapels, of which there were three round the choir aisles. The Lady chapel is brought gradually from a much greater width to the original dimensions, so as to interfere as little as possible with the light to the east window", WALLER. In 1514 the last abbot William Malverne or Mavern, alias Parker, was elected; he erected the vestry at the north end of the north transept, and the chapel on the north side of the choir for his own tomb. In 1741 a choir screen was put up by W. Kent, which was removed in 1820 for one by Sir R. Smirke, R.A., who also erected the altar screen.

The chapter house, 72 ft. long, 34 ft. wide, and 31 ft. 6 ins. high, was used a few years ago as the library; it is a very fine Norman room of similar date to the other Norman work, having a plain pointed vault with large ribs 15 ft. apart; arcades of twelve arches each, ornament the north and south walls; and at the west end are a Norman door and window; the east end, which dates about 1420, has a window of large size. Adjoining the cloisters are the little cloisters (probably a part of the old monastery), about 54 ft. by 52 ft.; the south entrance is Early English; a doorway led into the refectory, of which some of the arches remain. On the east side of the large cloister a door leads to the library, which was restored 1857-8, it was formerly used as the collegiate school, until the erection of a new one on the north side of the chapter house 1849-50 by J. R. Hamilton. A crypt extending under the choir and its chapels is apparently of the same date as the shell of the building, viz. Early Norman. The central tower and other portions are built of Bisley stone with Painswick stone above.

The restoration of the structure was begun 1848 by F. S. Waller, and is gradually progressing; the chief are the east and west fronts with their windows; the interior of the chapter room with encaustic tile floor after the original patterns; the library; the interior of the nave; the south aisle; one external compartment of the Lady chapel; a portion of the great clois-

ters; the roof of the north aisle; and the north clearstory of the nave. The pulpit was designed by the late R. C. Carpenter. Prof. WILLIS remarks, that "every example of style is early at Gloucester", and this cathedral and this district he believes to have been the school of Perpendicular architecture. The choir internally is one of the finest and earliest known examples of the Florid Gothic; and the groining of the roof is as complicated and enriched as any since constructed; the east window (1338) is unrivalled in size, it is in three distinct parts, comprising altogether fourteen lights, about 82 ft. high and 40 ft. wide, filled with fine stained glass containing forty-eight figures; an extra width being gained by a skilful architectural contrivance. The glass having been taken out, cleaned, rearranged, and releaded in 1862, is now one of the finest specimens of fourteenth century work extant. The celebrated whispering gallery, 3 ft. wide, and of the respective heights of 6 and 8 ft., and 75 ft. long, is a passage formed by five sides of irregular length, from one side of the choir to the other, at the back of the east window; masonry of Norman date is used in the arches supporting two of its sides.

The internal dimensions are, nave 180 ft. long, 41 ft. 2 ins. wide, and 67 ft. 7 ins. high; the north aisle 180 ft. long, 21 ft. wide, and 38 ft. 9 ins. high; the south aisle 180 ft. long, 22 ft. wide, and 40 ft. high; the nave and aisles 84 ft. 2 ins. across; the transepts each 53 ft. long, 35 ft. wide, and 78 ft. high; the choir 135 ft. long, 35 ft. wide, and 86 ft. high; the Lady chapel 91 ft. 6 ins. long, 26 ft. wide, and 46 ft. 6 ins. high; the total interior length is 406 ft. 6 ins., and the width 141 ft. The tower is 176 ft. from the ground to the leads, and 49 ft. to the top of the pinnacles; the width internally is 36 ft. by 35 ft. 6 ins.

A 'bracket' tomb is supposed to commemorate Aldred, archbishop of York, ob. 1069, or prior Serlo, ob. 1104, but is of later date; the effigy, of stone, holds the model of a church. A stone effigy ascribed to Osric, king of Northumberland, ob. 729, is of Perpendicular work; another of oak with chain mail, to Robert Curthose, duke of Normandy, ob. 1134, son of William I, is of late twelfth century work; there are effigies of Humphrey-de-Bohun, earl of Hereford, and his wife; and another in alabaster of Edward II, ob. 1327, is placed under a richly carved canopy. Among the more modern tombs are those of alderman Blackleach and his wife, 1639, by F. Fanelli; a statue to Dr. E. Jenner, ob. 21 January 1823, by R. W. Sievier; an altar tomb (Gothic) of Painswick stone to the Rev. R. Raikes, ob. 5 Sept. 1823, by the late T. Rickman; and a tomb to Mrs. Morley, by J. Flaxman, R.A.

A new episcopal palace is in course of erection (1862) by Ewan Christian. The deanery, anciently the residence of the prior, situate at the north-west angle of the cathedral, contains fragments of Norman and Early English work. Some vestiges exist of S. Oswald's priory, and some Early Norman piers and arches of the chapel of S. Catherine, founded 909, and demolished 1648; the Blackfriars' college, instituted 1239, was of considerable extent in 1366, some of the domestic portions and school now remain. The Greyfriars consisted of extensive buildings, parts of the north, south, and east walls of the chapel remain, being good Perpendicular work late in the fourteenth century. Of the ten parish churches, those of interest are S. Michael's, rebuilt 1819-50 by Messrs. Fulljames and Waller, with the exception of its massive tower of Perpendicular date; S. Mary-de-Crypt, the crypts and part of the west wall of which date cir. 1137; the greater portion is of the fourteenth century; the nave is 45 ft. long by 18 ft. wide, the chancel is of the same size, the transepts are each 16 ft. square; there is also a central tower; of the two crypts, one under the south and middle chancel is 41 ft. long and 11 ft. wide; the other is 42 ft. 6 ins. long and 16 ft. wide; the original altar slab, and some curious fresco painting of good drawing at the back of the sedilia, were found during the restoration 1840 by Messrs. Daukes and Hamilton; S. John the Baptist, has a tower and

spire, cir. 1485, the nave and body were rebuilt 1732-4: S. Mary-de-Lode, has a tower and chancel of Norman and Early English date, the remainder was rebuilt cir. 1824; a recumbent figure is said to represent king Lucius: S. Nicholas, is said to have been built by John duke of Gloucester, afterwards king of England; the stump spire has a mural coronet; a monument to alderman Walton, 1626, is given in BIGLAND. The modern churches are S. Aldates, 1750: S. Mark's (Early English), 1847 by F. Niblett: S. James, 1837 by S. Kempthorne: S. Luke, 1840 by T. Fulljames: and Christchurch, Spa, 1822 by Messrs. Rickman and Hutchinson. Among the chapels may be mentioned the Independents, 1851 (Decorated) by J. Medland; the Baptists, 1848 by J. Sims; and the Roman Catholic, 1860 by G. Blount of London, which at present consists of a chancel, Lady chapel, sacristy, and two-thirds of the nave and aisles; it is 101 ft. long, 39 ft. 6 ins. wide, and 41 ft. high. The Society of Friends erected a new meeting house 1834. The cemetery, consecrated 29 September 1857, was laid out and the chapels erected by Messrs. Medland and Maberly.

Among the public buildings are the tolsey or guildhall and post office 1749, on the site of the Roman forum: the shire-hall 1814-16, of Bath and Leckhampton stone, by Sir R. Smirke, R.A. (Grecian Ionic), is 82 ft. wide and 300 ft. deep; the assembly room on the upper floor is 87 ft. long, 53 ft. wide, and 50 ft. high, accommodates upwards of 2,000 persons; a bas-relief nearly 40 ft. long represents the signing of Magna Charta; this room is approached by a corridor 100 ft. long, 16 ft. wide, and 18 ft. high, ending in the staircase; on each side are the courts, each 76 ft. wide and 38 ft. deep, with a gallery holding 400 persons: the county gaol 1791, on Howard's principle, from the designs of Sir G. O. Paul, by J. Wheeler, cost £34,873; it was enlarged and rearranged on the separate system 1845-55 by T. Fulljames, to accommodate 500 prisoners: the general infirmary 1755 from designs by Luke Singleton, has been generally copied in others; the second building 1827 is by T. Rickman: the lunatic asylum 1822-3 by Collingwood after plans by W. Starke, cost £45,000; it is 225 ft. in extent, with accommodation for 270 persons, and 1848-60 was enlarged and remodelled and large detached wings erected by Messrs. Fulljames and Waller; it is now capable of containing upwards of 500 patients: the union workhouse, for thirty-seven parishes, was built 1839: the hospital of S. Bartholomew, founded in the reign of Henry II, was rebuilt 1789, with a chapel, and contains separate rooms for fifty-four persons: the united almshouses at Wotton 1860-1 by Messrs. Fulljames and Waller, contain in one establishment the three charities of S. Margaret, S. Mary Magdalen, and S. Kimbrose; two chapels in connection with the old buildings of these charities, viz. S. Mary Magdalen, of which its chancel and interesting Norman doorways still remain; and S. Margaret's is now used as a church for the new almshouses. The armoury of the South Gloucester militia, a massive fireproof stone structure, 1854-7 by Messrs. Fulljames and Waller, is of the English domestic architecture of the fifteenth century.

Among the educational establishments may be noticed the Blue Coat hospital, founded 1666, rebuilt 1807 on the site of the Roman praetorium, of Bath stone (Italian) by J. Wheeler, and cost upwards of £5,000; the collegiate school already noticed; and the Crypt grammar school, founded 1528, for which a new building has been erected 1862 for the accommodation of 400 boys, by Messrs. Medland and Maberly.

The extensive markets 1856, and the corn exchange 1857, are by Messrs. Medland and Maberly: the large cattle and cheese markets were commenced 1862 by R. Griffiths: a pump room and baths were erected on the discovery of the spa in 1814: the theatre was rebuilt 1857-8 by J. Blinkhorn, at a cost of nearly £3,000. The banking establishments consist of the Gloucestershire banking company 1836 by S. W. Daukes; the county of Gloucester bank (Grecian Corinthian) 1838 by T.

Fulljames; National Provincial bank (Gothic) 1846 by Messrs. Daukes and Hamilton, standing on the site of the house occupied by the late James Wood; and the savings bank 1850 by J. R. Hamilton. The railway stations comprise the Bristol and Birmingham, opened 1840; and the Great Western, opened 1845, with its connections the South Wales, and the Hereford, Ross, and Gloucester; the Cheltenham and Gloucester railway, 1837-45, was opened throughout in 1847.

At a very early period the casting of iron was carried on at Gloucester; in the fourteenth century, and until a recent period, a bell foundry was established by Ruddall and continued by that family. Large timber sawing works are in operation by the firms Eassie and Sons, and by Messrs. Treadwell; much of the timber for railway purposes has been kyanized and creosoted at this city. In the environs are the ruins of Llanthony priory, founded 1186, consisting of a gateway, barn, and some domestic offices.

BONNOR, *Views of G. Cath.*, 8vo., 1796 and 1816; ENGLEFIELD, *Antiq. of G. Cath.*, fol., 1809; WILLIS, *Survey of Cath.*, 4to., 1727-30; BUCKLER, *Views of Cath. Ch.*, 4to., 1822; BRITTON, *G. Cath.*, 4to., 1835; WINKLES, *English Caths.*, 8vo., 1836-42; CLARKE, *G. Cath.*, fol., 1850; and WALLER, *A. Gen. Descr. of the Cath.*, fol., 1856. The GLOUCESTER GUIDE, 12mo., 1792; FOSBROKE, *Original Hist. of G.*, 4to., 1819; COUNSELL, *Hist. of G.*, 8vo., 1829; DAVIES, *Stranger's Guide*, 8vo., 1834; and 1848; BOND, *Hist. of G.*, 8vo., 1848; NIBLET, *Handbook of G.*; and POWER, *New Handbook*, 1862. BIGLAND, *History of County of G.*, fol., 1786 and 1791; ATKYNS, *Ancient and Present State*, fol., 1712; and *Hist. of G. Shire*, fol., 1768; LYSONS, *G. Shire*, fol., 1833; LYSONS, *Collection of Gl. Antiq.*, fol. (coloured glass), 1804; RUDGE, *Hist. of County*, 8vo., 1803 and 1811; RUDDER, *Hist. of G. Shire*, fol., 1779; STORER, *Delin. of G. Shire*, 8vo., 1824; and BRAYLEY, *Beauties of England*, 8vo., 1804. Meeting of the British Archaeological Association, 1846, with papers by BRITTON and CRESY, reprinted in *BUILDER Journal*, iv, 373-4, 386-7; and of the Archaeological Institute, 1860, with papers by WILLIS and WESTMACOTT, reprinted in *BUILDER Journal*, xviii, 510, 553. T. F.

GLOUCESTER (JOHN DE). A "cementarius" employed by Henry III, who granted him freedom from all tallage and tolls throughout the realm for life; Close Roll, 39 H. III. In forty-first year, 1257-8, a gateway at Guildford was built, and other works done "by the view and counsel of master John of Gloucester, our mason, and master Alexander our carpenter"; in 1259 (forty-third year) the king's new chapel at Woodstock was to be paved by the advice of John; in the same year he was to supply figures in freestone to the wardens of the works of the church of S. Martin, London; in 1260 he was paid for certain works at Westminster; and received £410 to be distributed to the workmen at Windsor, whose wages were two years in arrear; he probably died in the same year, as the name of Robert de Beverley appears subsequently. TURNER, *Dom. Arch.*, 8vo., Lond., 1851, i, 248-51, 263; TIGHE and DAVIS, *Windsor*, 8vo., Lond., 1858, i, 79; WALPOLE, *Anecdotes*, edit. by WORNUM, 8vo., Lond., 1849, i, 13.

GLOVE. The attention of antiquaries has lately been drawn to the fact of notices in the Fabric and other rolls connected with the mediæval structures, respecting the gift of tunics, aprons, and clogs; and also gloves to masons and carpenters for the preservation of their hands. Thus BROWNE, *York Cath.*, 4to., London, 1838-47, notes 1370 the gift of gloves to the carpenters for elevating the great ceiling, 4s. 6d., p. 168; 1372-3, six pair for raising the timber, 12d., p. 98; 1401, remuneration to the setters at the walls, by aprons and gloves, for the year, 9s. 10d., p. 201; and 1434, four pair to two masons for laying stones, 6d., p. 232. As is also mentioned by OLIVER, *Exeter Cath.*, 8vo., Lond., 1861, p. 385; in *A Brief Account of Durham Cath.* (by RAINE), 8vo., Durham, 1833, p. 90; and HOPE, *Architecture*, 8vo., London, 1840, p. 211, who notices that the churchwardens of a parish in Suffolk 1430

agreed to provide every freemason with a pair of white leather gloves and a white apron during the works. The custom existed as late as 1629-31; Accounts of building Heriot's hospital, Edinburgh, given in the *Transactions* of Arch. Inst. of Scotland, 8vo., Edinburgh, 1852, ii, 34-40.

DIDRON, in *Annales Archéologiques*, notes that in 1381 the châtelain of Villaines en Duemois bought a considerable quantity of gloves to give to the workmen in order "to shield their hands from the stone and lime". In October 1383, three dozen gloves were distributed to the masons when they began the buildings at the chartreuse of Dijon. At Amiens in 1486-7 twenty-two pair of gloves were given to the masons and stone cutters. In stained glass representations of workmen at work, gloves are shewn on their hands; WRIGHT, in *Journal of Archaeological Association*, 8vo., London, 1845, i, 23; reprinted in his *Essays*, etc., 8vo., London, 1861; and in *BUILDER Journal*, iii, 246. Many other later instances of the practice might be cited, but the above are perhaps the earliest notices.

GLOVER (MOSES), "painter and architect", is inscribed on a survey made temp. James I, of Sion, Middlesex, with the adjoining villages, containing views of the neighbouring royal houses and seats, preserved at Sion. Together with G. Christmas and B. Jansen, he is supposed to have built 1605, or completed, Northampton, afterwards Northumberland house, London; and probably Sion house, on which Henry Howard, earl of Northampton, expended £9,000. DALLAWAY, *Discourses*, 8vo., London, 1833, 357; WALPOLE, *Anecdotes*, edit. by WORMUM, 8vo., London, 1849, i, 250. Stoke park, Northamptonshire, has also been attributed to him, but CAMPBELL, *Vit. Brit.*, fol., London, 1731, iii, pl. 9, fixes its commencement by I. Jones about 1640. 19.

GLUE (It. *colla*; Sp. *cola*; Fr. *colle*, *glu* is bird lime; Ger. *leim*). A viscid tenacious matter, of divers kinds, used in the various arts, as a cement to connect objects together. It is made of gelatinous matters, soluble in water, derived from the remains of animals and fish: glue made from the latter is rarely used in building operations. Common or animal glue is made from certain portions of the skins, tendons, bones, intestines, etc., of oxen, horses, sheep, and some other domestic animals, macerated in lime water, then subjected to further chemical action for the purpose of purification, and ultimately reduced by the action of boiling to the required consistency.

There are several descriptions of glue; the one most commonly used is the carpenters' and joiners' glue; the size (Fr. *colle de Flandre*), and the glue used in limewhitening walls, or for colouring them in distemper. The first is semi-transparent, formed into fragile and brittle plates, of a neat clean fracture, soluble in cold water, and only retains its property of agglutinating other substances when it is remarkably pure. Hatters' glue may be considered a variety of this material; it is brown in colour, without transparence, soft and hygrometric, and very soluble in cold water; it is, in fact, of little use in such situations as are exposed to great changes of atmosphere. Size, or *colle de Flandre*, and the glue used for whitening walls, etc., are whitish and transparent, and not sufficiently firm to be sold in regular cakes; they are generally packed in barrels, and their preservation is much assisted by the admixture of a little alum water; both these materials are used by house painters. To use joiners' glue it is broken into small pieces, soaked, and then melted with water in a pot which is a double vessel or water bath, the inner one for the glue, the outer one for water, in order that the temperature applied may never exceed that of boiling water: in this melted state it serves to form the joints of work intended to resist the action of the weather, provided moisture cannot obtain access to it. The commoner descriptions of gelatine are really nothing more than common kinds of glue. In their preparation the quantity of bone is very large, and indeed bone seems to be almost entirely composed of that material—a fact of which Dr. Buckland made great use in injecting the decayed ivory obtained from Nimroud with gla-

tine. Unsuccessful attempts have been made to apply bones to the manufacture of glue, by treating them with hydrochloric acid. URE, *Dict. of Arts*; HOFFER, *Dict. de Chimie*; GUILLAUMIN, *Dict. du Commerce*, 1861. CLEARCOAL. G. R. B.

Marine glue, invented about 1841 by Alfred Jeffery, is composed of caoutchouc and naphtha, to which shell-lac is added and then heated until the whole is amalgamated. This glue is insoluble in, and impervious to, water, elastic, sufficiently solid to give strength, and adhesive to an intense degree; *Report of an Admiralty Commission*, 1850-1; JEFFERY, *Notes on the Marine Glue*, 8vo., London, 1843; *On the Progress of the Marine Glue*, 8vo., London, 1846; and *Marine Glue, its advantages*, etc., 8vo., London, 1848; *BUILDER Journal*, ix, 19; *SOCIETY OF ARTS, Transactions*, liv, 188; *PENNY MAGAZINE*, 1845, xiv, 331. During the execution of some contract works, this glue was found to solidify long before the workmen could make a joint. Numerous experiments made in June 1842 by F. G. Mulholland resulted in the formation of a glue which allowed the work to proceed satisfactorily: apparently this composition was patented 27 December 1855 by J. E. Cook, and was said to be made of shell-lac dissolved in methylated spirit: W. L. Scott detailed his mode of making this liquid glue; *BUILDER Journal*, xiv, 531, 585, 614. Another liquid glue, which will keep for a length of time ready for use, is formed of strong glue dissolved in water to which a small quantity of nitric acid has been added; it is described by DUMOULIN, in *Comptes Rendus de l'Académie des Sciences*, given in the same *Journal*, 1853, ix, 221; xiv, 24; xix, 384. A waterproof glue, said to be a cheaper kind of Marine glue, was patented 1861 by W. J. Hay of Portsmouth; the materials are Trinidad pitch or asphalt, tar, and oil naphtha, or in lieu of the latter, rough creasote, or oil of turpentine; it is also offered as a black paint for covering metal, timber, etc., and as a damp course in foundations; while his India rubber varnish enables a damp wall to be papered over directly; an old plastered wall must, however, be newly prepared for the varnish; *MINING Journal*; *BUILDER Journal*, xix, 656.

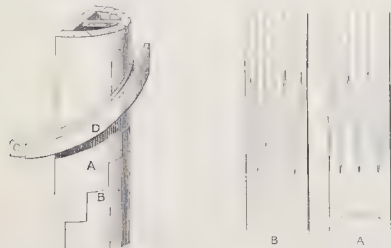
White lead, ground in a small quantity of linseed oil, until it is strong but not thick, forms a good glue for outside work. The same boiled into a varnish with litharge will harden in about forty-eight hours, rendering the joints of wood cisterns air and water tight: URE, *Dict.*; GWILT, *Encyc.* The lip glue (Fr. *col à la bouche*) used by architects and others for fastening paper, only requires to be moistened in the mouth.

GLUING. When applied to the end grain of wood, glue is rapidly absorbed into the pores; the workman therefore puts at first upon the end enough glue to fill the grain, and repeats the process until the usual quantity will remain upon the surface: glue, however, never holds so well on the end as on the side of fibre. Mahogany and deal are considered to hold, better than other woods, the glue which is supposed to act in two ways, viz. by adhesion, and by exclusion of air. Although it has been asserted that the exclusion of air, so as to bring into play the pressure of the atmosphere, is an insufficient explanation of this action, the ordinary mode of forcing glue as much as possible from between the pieces of wood intended to be joined, recalls the experiment of expelling the air from between two polished plates, whose mere contact will then be found equal to resist a considerable force applied to separate them. With regard to simple adhesion, it is true that some glue is so strong in itself that the neighbouring wood, to which it is applied, will sooner break than the glue, as is testified by many split panels. But it is not safe, in joinery, to trust to the quantity or thickness of the glue, for that joint holds the best in which the pieces of stuff are brought the most closely into contact: for example, when the edges of two boards are to be glued together, they are accurately planed, and while one board, being fixed in the bench, supports an arris of the other, the two edges are smeared with the glue-brush, immediately placed in con-

tact and rubbed upon each other lengthwise to force out as much of the glue as possible. When the glue begins to prove stiff, the two boards are brought into their intended position and are left to dry in the bench, or else resting their whole length against another piece of wood placed nearly perpendicular. Even where work is held together by dovetails, etc., it is desirable to use clamps to keep the work true while the glue is drying; these clamps are of various sorts; and in delicate work it is usual to provide boards, called *cauls*, to save the material from being disfigured by the clamps. These cauls are planed to suit the intended surface of the finished work, and are heated with the object of keeping the glue liquid, until the clamps are securely applied: some persons think that the heat assists afterwards to dry the glue. Such cauls are of course made counterparts to curves, such as moldings, and where the work is circular, or circular circular, the cauls are composed of many wedges strung together through a hole at each end of each piece. HOLTZAPFEL, *Woods*, 8vo., London, 1843. VENEER.

GLUING UP. The term used in practical or constructive joinery, to the way in which bodies are fastened together for different purposes. Such as joining two boards edge to edge; two boards at right angles, and at an oblique angle by blocks, which operation repeated is the way columns and their bases are glued up; the securing of the several pieces of wood forming an architrave; also for forming a solid niche head; the fastening of veneers together for the purpose of forming cylindrical and for concave surfaces; and capitals of columns are formed out of a mass of woodwork glued up in blocks; globes or spheres, and conical bodies are likewise formed by the same method. The operation, as detailed by the aid of the requisite diagrams, is shown in GWILT, *Encycl.*, p. 579; STUART, *Dict.*, s. v. Constructive Carpentry. BLOCK.

GLUING UP IN THICKNESS. This is an important operation in joinery. It is used in forming those curved articles, as wreathed strings, and hand rails, chord bars to sashes, and similar work, which otherwise must be worked out of the solid, and if so, and in quick curves, the grain must be cut across in such a way as seriously to weaken the stuff. In hand rails it also entails considerable labour in getting out the lines, in making falling molds and face molds, and very great loss of stuff if cut out of the solid. It is true the lines of the glued joints will show slightly in stuff glued up in thickness, but in rich dark Spanish mahogany this is so trifling as to be scarcely perceptible. In staircase work this operation is thus performed. A semi-cylinder, *A*, is made of deal to the proper diameter well braced and blocked inside, and the outside surface planed up true. The lines for the ends of the treads and risers, *B*, and also for the hand rail, are then traced on the surface. A thin slip of mahogany, *C*, is bent round the cylinder exactly according to the line of the rail, and held in its place by slight tacks. Round this a second piece, *D*, is also wound, but this is well glued and secured to the first also by tacks. Thickness after thickness is thus glued one on the other till the required size of rail is formed. When thoroughly dry the tacks are removed, and the whole planed and molded to the required sections. The



heading joints are made as at *A* if the glued-up portion joins into a piece of solid rail; as at *B* if into another glued-up piece.

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If done well, it is difficult to perceive them. The cylinders are generally made of a slightly quicker curve than the intended work, as the stuff is always inclined to spring back a little when released from the tacks. Deal wreathed strings are glued up much on the same plan. Chord bars to circular headed sashes, soffits over circular headed openings, etc., are also executed in a similar way. A. A.

GLYPH (Gr. *γλυφίς*, the notch at the foot of an arrow). A term which has been adopted by English writers for any channel or groove, but especially for the channels on the ends of the beams between the metopes of the Doric order, where the combination of glyphs is called, according to the number, DIGLYPH (properly dyglyph) and TRIGLYPH. DONALDSON, *Temple at Bassæ*, in STUART, *Athens*, supp. vol., fol., London, 1830, p. 12, gives nine specimens of the mode of arranging the heads of the glyphs and semiglyphs.

GLYPTOTHEK (Gr. *γλυπτὰ*, things carved, and *θήκη*, a receptacle). The term first adopted for buildings at Munich in Bavaria, is now used for a gallery of sculptured works. SCULPTURE GALLERY.

GMELINA arborea, *Gomar*, or *Gambhari* wood, is abundant in the Morung or Chittagong forests of Hindostan. It forms a large timber tree, commonly used in the Vizagapatam districts for the foundations of walls and other purposes, where it is to be submerged in water, when it is remarkably durable. The wood is light, of a pale yellow colour, easily worked, and does not shrink or warp; and though weak, it is held in great estimation for picture frames, sounding boards, organ pipes, Venetian blinds, and all sorts of light work in which shrinkage is to be avoided. It weighs 32 lbs. 3 oz. per cube foot. 71.

ROXBURGH, *Flora Indica*, 8vo., Serampore, 1832, iii, 85, states that the *Goombar* or *Koomhar* wood squares into logs of from 18 to 24 ins., and occasionally nearly 30 ft. long. The wood resembles teak, the colour being the same; the grain rather closer, but it is somewhat lighter. He placed an outside plank for three years in the river Hoogly, a little above low-water mark, exactly where the worm is thought to exert its greatest power, but it was not attacked. In another trial, this wood remained perfect during seven years, whilst teak, similarly placed, required to be renewed after six years. 14.

GMUENDEN or **VON GEMUNDEN** (HEINRICH), called Enrico di Gamodia or ZAMODIA by Italian authors, was invited to Milan, where he arrived at the end of November 1391, by the wardens of the works at the cathedral, who engaged him for three months from 10 December "with one companion" (probably his interpreter, as he could not speak Italian) at a salary of 45 florins, lodgings, wine, and a cartload of fuel. Having revived the disputes raised by FERNACH about the system of design, he was dismissed in consequence of the adoption of the triangular system by the Italians; and was succeeded by Mignot in a similar career. MILLIN, *Voyage dans le Milanais*, 8vo., Paris, 1817, i, 28, confuses into Giovanni Enrico Omodeo, this E. di Gamodia and his successor G. A. Omodeo; besides falling into other errors noted by FRANCHETTI, *Storia*, 4to., Milan, 1821, p. 19. The design of the certosa at Pavia is traditionally ascribed to E. di Gamodia (the first stone was laid 8 September 1396, but the façade by A. Fossano dates 1473) by MALASPINA, *Guida*, 4to., Pavia, 1819, p. 111.

It has been supposed by HAGEN, *Briefe*, 12mo., Breslau, 1819, i, 9, and 263, that Heinrich von Gmuenden, living for some time in Italy, was Heinrich Ahrlor, who commenced 1351 the church of the Holy Cross at Gmuend, and that he was the father of Pietro ARLERI or ARLIERI of Bologna (? Polonia) who died 1392 and is called on his tomb Peter of Gemund. 26.

GMUENDEN (JOHANN VON) was baumeister 1359 at the munster of Freiburg im Breisgau. If Pietro di Giovanni di Freiburg, employed 1402 on the cathedral at Orvieto, be supposed to have been his son (STIEGLITZ, *Alldeutsche Bau-*

kunst, 4to., Leipsic, 1820, p. 175, however, speaks of him without citing any authority as J. P. FERNACH, employed previously at Milan and at Florence), the Cristofano Tedesco, also working on the cathedral at Orvieto, would probably be the grandson of this Johann von Gmuenden. DELLA VALLE, *Storia*, 4to., Rome, 1791, pp. 120, 122, 291, 382.

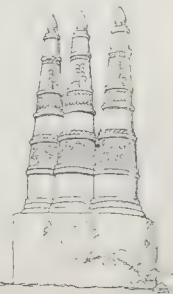
GNEISS. The German name, adopted by English geologists, for the lowest series of stratified primary rocks. It may be said to consist, like granite, of quartz, felspar, mica, and hornblende; though MACCULLOCH, *Geological Classification*, 8vo., London, 1821, p. 249-66, and *System of Geology*, 8vo., London, 1831, ii, 141-57, has shewn that the gneiss tracts of Scotland furnish the means of considering gneiss in three divisions: the first, regular composition, containing at least two of the above named minerals; the second, irregular composition, containing compact felspar; and the third, irregular composition in other respects. In some conditions the mica is so abundant as to form a schistose rock: in others each substance occupies a distinct lamina: the gneiss used instead of roofing slates round Viallas (Lozère) in France, and that used as flags for pavements in some parts of North America, have this schistose character.

GNESEN (Polish, Gniezna). The seat of an archiepiscopal see, united since 1821 to that of Posen, in Prussian Poland. The cathedral, dedicated to S. Adalbert and the Assumption of the B. Virgin, dates 1360 according to MERTENS. It is a large building with two western brick towers and spires; but it was much altered and cased with marble in the sixteenth and following centuries. It is chiefly remarkable for highly decorated chapels with rich monuments; the large brass slab of archbishop Senne (ob. 1480); the bronze bas-relief effigies of similar date; the silver shrine of S. Adalbert, placed under a baldaquin about 40 ft. high with four twisted marble columns, all dating 1767; and the bronze doors, of the principal entrance at the south side of the nave near the west end, which are each about 10 ft. high and 3 ft. wide, and are described, with illustrations, in the *ARCHÆOLOGICAL JOURNAL*, 1852, ix, 214, 339, as dating about 1150-1200. Four parish churches, a seminary, a monastery, a nunnery, the government offices, and a Protestant church, are the principal buildings; the archiepiscopal palace is now a ruin. 28. 50. 92. 96.

GOA. A city in the province of Bejapore in Hindostan. This name of the capital of the Portuguese possessions in the East has been applied to three places; one of which declined when a new Goa was built 1479 about two miles distant from it; the third, also called new Goa or Panjim, was founded 1758 about five miles nearer than the second to the harbour. The second city was declining rapidly 1641-8, as described by TAVERNIER; and a very confused account of the recent state of the two later cities with their dependencies is given in FORBES, *Oriental Memoirs*, 4to., London, 1813, i, 293; COTTINEAU DE KLOGUEN, *Goa*, 8vo., Madras, 1831; and BURTON, *Goa*, etc., 12mo., London, 1851: the latter gives a view of the cathedral, and enumerates besides the houses of stone in two stories with red tiled roofs, the governor's palace, the archbishop's palace, the churches of S. Conceição and S. Sebastian, the library, the *conditoria*, the custom house or *alfandiga*, the theatre, the hospital, the jail, the printing house, the barracks, and the bazaar, as the principal features, which though large possess but little beauty.

GOAD. An old name for a measure equal to 54 ins. 14.

GOAL. The mark set up to bound a race. This is the *meta*, standing at the ends of the *spina* in the Roman circus, as represented on bas-reliefs and medals, and designating the *curvus* of the ancient games. It appears



as consisting of three conical pointed pillars raised upon a pedestal, in the accompanying illustration derived from a marble in the British Museum.

T. L. D.

GOBAN, who flourished in Ireland in the seventh century, is still commemorated by the peasantry, as 'Goban Saer' or Goban the artificer, thus confirming the ancient prediction of the old writer "famosissimus in omni arte lignorum et lapidum erat in Hibernia nomine Gobbanus, cujus artis fama usque in finem sæculi erit in ea." His father Tuirbhi possessed the locality a few miles from Dublin, now styled Turvey, and formerly called 'Traigh Tuirbhi' or the Strand of Tuirbhi, the affectionate keen father of Goban. The old Brehon laws required that the 'Ollamh Saer' or chief builders should be proficient in the art of erecting bridges, the payment for which was minutely regulated; GILBERT, *Hist. of Dublin*, 8vo., Dublin, 1854-9, i, 321.

GOBBETT. A term employed in the accounts for building S. Stephen's chapel, Westminster, "1330 June; To 400 Caen stones called Gobbetts", at £4 each hundred; BRAYLEY and BRITTON, *Palace*, etc., 8vo., London, 1837, p. 150. 16. 19.

GOBBO (II), see SOLARI (CRISTOFORO).

GOBERT (. . .). The list of the members of the Academy of Architecture in Paris mentions a GOBERT elected in 1680, and another GOBERT admitted in 1690. The house, afterwards the property of the president de Brou, in the rue de l'Université, was built 1701 by a Gobert; BRICQ, *Descr.*, 12mo., Paris, 1725, iv, 60: and the decoration of the interior of the great gallery of the library of the church of the Augustins Deschaussés or Petits Pères was designed by Gobert and Leduc, before 1704, both having the title of royal architects; BLONDEL, *Arch. Franç.*, fol., Paris, 1772, iii, 22. 5.

GODDE (ÉTIENNE HIPPOLYTE), born 26 Dec. 1781 at Breteuil (Oise), was a pupil of de Lagardette. He built the church of the commune of Boves (Somme); restored the cathedral at Amiens, the church at Corbie, and many churches at Paris; where he erected 1820-38 the seminary of S. Sulpice, rue du Pot de Fer, at a cost of 2,300,000 fr., and the site, etc., 900,000 fr.; GOURLIER, etc., *Choix*, fol., Paris, 1825-50, ii, 236-8; also the churches of Notre Dame de Bonne Nouvelle; of S. Denis and of S. Sacrement, rue S. Louis; and of S. Pierre at Chaillot; enlarged the church of Ste. Elizabeth; erected the chapel and entrance gates of the cemetery of Père la Chaise, with the tombs of marshal Pérignon, and of the family Frochot there; the entrance gate of the cimetière du Sud, and its buildings; planned the new quartier di Tivoli; and erected seven *hôtels* in the rue de Londres. The above works, with many private houses, were all executed between 1806 and 1829. At Paris in 1819, having found that slips of paper pasted over the cracks were torn the next day, Godde shored up the church of S. Germain des Prés, to support the vaulting and arches, while the pillars and walls, except the towers, which he destroyed, were being rebuilt from the footings.

He obtained a first prize, and 1800 the second *grand prix*; in 1805 was *inspecteur* under Legrand; and in 1813 was nominated *architecte inspecteur en chef* of the second section of public works: at this period he was instructed to make plans, elevations, and sections of the churches of Paris; the collection, consisting of three hundred and six drawings, is among the records of the city. He was also appointed at that time architect to the city, in which capacity he remained until his resignation 1852, having continued 1837-49 with Lesneur the hôtel de ville begun by Boccadoro, given in GOURLIER, iii, 376, etc.; and in 1841 the cathedral of Notre Dame was entrusted to him for thorough repair and renewal. He died about 1854. 110.

GODEAU, see GODET (. . .).

GODEPERE. A rather hard, fine, close-grained, and heavy wood of Ceylon. 71.

GODETZ (A. DES), see DESGODETZ (ANTOINE).

GODMANSTON or **GODMERSTONE** (JOHN) had letters patent addressed to him as 'clerk', 17 Richard II, 21 Jan. 1394,

appointing him "to repair the great hall within the palace at Westminster, to take workmen, and set them to the said repairs; also to take stone as should be necessary for the work; and to sell the old materials of the hall, together with a certain old bridge over the Thames", etc.; Rot. Pat. p. i, m. 3; BRAYLEY and BRITTON, *Palace*, etc., 8vo., 1836, 437, who quote it for the first time. He is called "clerk of the works of the king's great hall", 30 April 1395, when he had £133:6:8 paid to him for the works there; DEVONS, *Issues*, 4to., Lond., 1837, p. 259. Stow, edit. STRYPE, fol., Lond., 1720, b. vi, 48, is thus wrong in stating that the hall was "begun to be repaired in 1397"; and perhaps also that "John Boterell being then clerk of the works", but he might have succeeded to Godmanston. The following relates to the same works; "Counter roll of Master Hugh Herland, one of the king's carpenters, of the payments made by John Godmanston, clerk, relating to the repair of the king's great hall within the palace of Westminster, and also of the making of the bell tower there (carried up 34 ft. higher), and the making of a porch and steps to the king's chapel of S. Stephen, begun anew; and also relating to the repairs and mending of the queen's bridge without the palace", etc. This roll extending from Easter, anno 18 Richard II, was delivered by "H. Herland, carpenter, controller of John Godmanston, clerk of the within works, 6 May, 19 Richard II"; SMITH, *Antiq. of Westminster*, 4to., London, 1807, 180, 222. The hall, Stowe says, was finished in 1399.

GODOT (. . .) was elected 1739 a member of the Academy of Architecture at Paris, where he died 1762. He is called Godeau by PATTE, *Monumens*, fol., Paris, 1767, p. 121, who notices the plan submitted by him about 1752 for the place Louis XV.

GODOWN, properly *gudam*. The Bengalese term for a warehouse or cellar.

GODROON, sometimes written GADROON. This term seems to be derived from the Fr. *godron*, meaning a puffy plait in linen. It has long been used by decorators to designate an ornament that in its simplest form, *g*, arises from cutting the centre, *A*, out of a length of beads so as to leave two lengths. The most common form is *x*, in which the faces of the beads are elliptic sculptured, and separated by one or more reels. If a length of godroon be divided along its centre, *E F*, the operation produces two lengths of KNULLING, which is also called *godron*



in France. The decorators in Paris have distinct terms for these patterns, as *g*, *godron en noyau*; *h*, *godron de relief*; *j*, *godron creuz*; *k*, *miroir*; the upper part *godron fleuroné*; *l*, *plastron*; *m*, *entrelas*.

GODSTONE STONE. Stone obtained near Reigate in Surrey, and commonly called FIRESTONE; it closely resembles GATTON STONE, obtained near the same locality, and probably employed at the same places. These stones require to be kept above the ground, or above the influence of capillary attraction upon the moisture it may contain, and also to be protected from rain. If these precautions be observed the firestones do not rapidly decay: for internal elaborate Gothic tracery, they may be advantageously employed, because the ease, with which they are worked, reduces the cost of labour of such decorations. They are extensively used also as hearths, covings, and for door jambs, lintels, etc., of fireproof rooms. The lime from this stone is noticed *s. v.* DORKING LIME.

MERTHAM QUARRY; KENTISH RAG.

GOERLITZ (CONRAD VON) and his partner Urban Laubansch finished 1497 the vaulting of the Petri Pauli kirche at Goerlitz in Silesia.

92.

GOERTZ, GOERITZ, or GORIZIA. A city in the province ARCH. PUB. SOC.

of Carinthia in the Austrian dominions. The upper town (1473) is a walled amphitheatre, and has an old castle; the lower town extends on the plain at the left bank of the Isonzo. The chief buildings are the cathedral, dedicated to SS. Hilary and Tatian, a parish and three other churches, one nunnery, the archiepiscopal palace, the seminary, the hospital, the government offices, the town-hall, the theatre, and the barrack, formerly the Jesuit college, in the great square. 28. 50. 96.

GOETGHEBUER (JACQUES) was born 17 November 1760 at Ghent, where he built three large houses in the rue de la Monnaie, and the gallery of casts in the academy. He was joint architect with J. B. van de Capelle of a country house at Nevele, about ten miles from that city. He died at Ghent 2 March 1825. 101.

GOETGHEBUER (PIERRE JACQUES), born 26 February 1788 at Ghent, was a son of the preceding, and a pupil of Broe. After erecting the hôtel de la Poste in the Wapenplaats at his native city, he confined himself to engraving and literature. He published *Choix de monumens, édifices, et maisons les plus remarquables du royaume des Pays Bas*, fol., Ghent, 1827. His brother FRANÇOIS JOSEPH, born 6 January 1798, was a pupil of Roelandt, and obtained 1821 and 1825 the *grand prix* given by the academy. He designed several buildings at Ghent; the château van Mussain near Halle; and died 26 July 1836. 68. 101.

GOETHE (EOSANDER VON), see EOSANDER (J. F.)

GOING OF THE STAIR. The term given to the clear width of a flight of steps. 1.

GOIT, see GOUT or GOWT.

GOKRA. A term used for a balcony in Hindostan.

GOLA or GULA, see CYMA.

GOLA and GÜLZAR. Terms used in Hindostan for beadings or stringcourses; KITTOE, *Illustrations*, fol., Calcutta, 1838.

GOLCONDA. A fortress about five miles from Hyderabad, in Hindostan. It was the capital of an extensive kingdom; but the tombs of the monarchs of the Kuttub Shahi dynasty 1512-1686 are the only architectural works of any importance: these are shewn in GRINDLAY, *Scenery*, fol., London, 1830; and in TAYLOR, *Sketches in the Deccan*.

GOLD (JAMES). It is stated by MALCOLM, *Lond. Rediv.*, 4to., 1803, i, 335, that "the plan of the new church and steeple" of S. Botolph, Bishopsgate-street Without, London, was by him. GODWIN, *Churches*, etc., 8vo., 1839, s. v., appears to confirm this statement. The church was erected 10 April 1725-8, under the Act of Parliament 1723, 10 George I, c. 5; the cost was not to exceed £8,000. A print of it published in 1802 has the name "G. Dance, 1727, archit.", probably the grandfather, Giles Dance: LANGLEY, *London Prices*, 8vo., London, 1750, 246, refers the building to John James.

GOLD. This metal, which has the advantage of not rusting (*i. e.* of not uniting with oxygen), occurs in its native state in the primary form of a cube, but crystallizes in octohedrons after fusion. While in a melted state it has a brilliant green colour; it contracts more than any other metal on cooling; its specific gravity is 19.3. Nothing seems to be known of the compounds which it forms with the bases of the alkalis and earths, as aluminium, calcium, potassium, etc.; in composition with the metals its ductility is generally greatly affected; the fumes of lead deprive it of that malleability. The addition of copper diminishes its density, but increases its hardness; the usual quantity of copper used in alloy by goldsmiths is 23.6 per cent., and the mixture tarnishes by reason of the oxidation of the copper, but the original reddish colour is restored by the application of ammonia. The combination of mercury with gold forms a white alloy, called an amalgam, which was the only means for gilding metals until the invention of ELECTRO-METALLURGY. Great ductility is obtained by adding silver to gold; a pale colour is produced by 5 per cent. of silver; and the compound, known as *electrum*, is usually

64 gold with 36 silver, being as nearly as possible one equivalent of each metal.

Gold is used for the purposes of ornamentation in the form of gold-leaf. The metal, after being purified and alloyed to the required colour, is rolled into a sort of thin ribbon. It is then annealed, cut into small pieces, placed between the leaves of a book made of tough paper technically called a 'cutch', and beaten by a hammer weighing 16 or 18 lbs., for a considerable time. The sheets of gold are then transferred to a book made of leaves of skin which is called a 'shoder', and beaten by a lighter hammer about 9 lbs. in weight, an operation which occupies two hours. When they have been extended to the full size of the book, each leaf is taken out, cut into four parts, and then placed between the leaves of another book formed of the finest gold beaters' skin called a 'mould', which is beaten upon by a 7 lb. hammer for four hours, when it is found to be of the thickness generally used. The gold leaves are then cut into squares about $3\frac{1}{2}$ sq. (or $3\frac{1}{2}$ by $3\frac{1}{2}$ ins., or $3\frac{1}{2}$ by 3 ins.) and placed between sheets of paper in a book containing twenty-five leaves. A book of gold, it is said, will cover $1\frac{1}{2}$ ft. super., though the *Price Book* limits that quantity to cover one foot super. of plain work. The three thicknesses of gold-leaf generally used, are 'single', 'double', and 'thirds'; the former being the commonest. BRASS; DUTCH FOIL; GILDING. A. A.

GOLDCLIFF (HUGO DE), was the chief of a number of chosen *cementarii*, employed by John de Cella, abbot of S. Alban's, 1195-1214 to rebuild the front wall of the church. He is called 'a deceitful but clever workman', with other notices of his character, in *Vita Vig. Trium. Ab. S. Albani*, edit. WATS, fol., London, 1639, p. 103; and BUCKLER, *S. Alban's Abbey*, 8vo., London, 1847, p. 83-4.

GOLDICUTT (JOHN), F.R.I.B.A., born 1793, became a pupil of J. Hakewill, as well as of the Royal Academy of Arts in London, where he obtained the silver medal for measured drawings of the façade of the Mansion House in 1814, about which period he entered the school of A. Leclère at Paris, and also competed for the monthly prizes in the Académie des Beaux Arts. He then travelled into Italy, collecting sketches for the works he afterwards published; 1817-8 he made a careful coloured drawing, from actual admeasurement, of the transverse section of S. Peter's church at Rome, shewing the decorations and paintings; this was submitted to the pope, who presented him with a large gold medallion; the drawing was exhibited at the Royal Academy of Arts in London 1819, on his return to England. In 1820 he obtained the third premium in the competition for the Post Office, London; and 1829 a premium for the Middlesex lunatic asylum; he also competed 1823 for the new buildings for King's college, Cambridge; 1830 for the Fishmongers' hall, London bridge; 1839 for the Royal Exchange; and 1841 for the Nelson monument; his design for the latter consisted of a colossal figure of Nelson standing on an immense globe placed on a pedestal in the centre of a large basin forming a fountain. At the Royal Academy of Arts, besides the above named drawing, he exhibited 1828 a design for a marine villa for S. Halliday, Esq., at West Cowes, Isle of Wight; 1830 for a casino on the esplanade at Worthing; and for alterations at Dell villa, Windsor, for the Hon. H. R. Westenra, M.P.; 1833 for a naval monument for Trafalgar-square; 1836 for a new terrace, and alterations to the west front at Dingley Park, for H. H. Hungerford, Esq.; besides several drawings of his continental studies. Various alterations were made by him at White's club house, S. James's-street; and, with G. Gutch, he erected 1841-3 S. James's church, Sussex-gardens, Paddington, at a cost of £9,600; this was nearly completed at his death. He died 3 October 1842, aged 49, and was buried in the Kensal-green cemetery.

He was one of the two first honorary secretaries of the Institute of British Architects 1834-6; he originated the presentation of a testimonial to Sir John Soane, and directed the em-

bellishments of the Freemasons' hall on the occasion of the festival 24 March 1835; *ATHENÆUM Journal*, 245; the record of these proceedings are in the Institute library. He was elected a member of the Academy of S. Luke at Rome (before 1818); and of the Academy of the Fine Arts at Naples; and was surveyor in the district of S. Clement Danes with S. Mary-le-Strand. He published *Antiquities of Sicily*, fol., London, 1819, most of the plates being etched by Pinelli; *Specimens of Ancient Decorations from Pompeii*, 4to., 1825; *Heriot's Hospital, Edinburgh*, 4to., 1826, the plates being etched by himself; and a pamphlet shewing his design for the Nelson monument, 8vo., 1841; and read several communications at the meetings of the Institute. CIVIL ENGINEER *Journal*, v, 372.

GOLDING (JOHN) was 1438, 16 Henry VI, made chief carpenter, and disposer and surveyor of the king's works in the palace of Westminster and at the tower of London, with a yearly fee of £20; Patent Rolls, noted by BRAYLEY and BRITTON, *Palace of Westm.*, 8vo., London, 1836, 314; John Arderne was clerk of the king's works; and John Whattley was appointed to the same offices 1445, 23 Henry VI.

GOLDMANN (NICOLAS), born at Breslau 1623, was appointed professor of architecture and mathematics at the university of Leyden, and is best known by his writings; amongst them are, *De Quinque Ordinibus Architecturæ*, fol., Lug. Bat., 1622; *Elementa Architecturæ Militaris*, 8vo., 1643, and fol., Leyden, 1645; *De Usu Proportionarii Circuli*; and *De Stylo-metricis*, fol., Lug. Bat., 1662. STURM'S *Vollständige Anweisung zur der Civil Baukunst der G.*, fol., Guelpherbyti, 1696, and fol., Augsburg, 1716, contains the life of Goldmann, whose method of geometrically drawing Ionic volutes was published in the *Vitruvius*, fol., Amst., 1649, and one is given in CHAMBERS, *Civil Arch.*, fol., London, 1759. He died at Leyden in 1663; STUART and NAGLER say 1665, aged 42 years. 24.

GOLD PAINT. A patent was obtained 13 January 1844 by Henry Bessemer for a combination, consisting of metallic powders (known as bronze powder) with gum-resins, oil, and turpentine, in such proportions as to form a fluid, capable of being used in the same way as oil paint. The details are given in the LONDON JOURNAL; the CIVIL ENGINEER *Journal*, 1845, viii, 55; and remarks on it in the BUILDER *Journal*, ii, 74.

GOLD PAPERS. The expression commonly applied to paperhangings in which part of the ornament is printed in metal which is chiefly used on satin and flock papers. Occasionally, but very seldom, real gold leaf is used; otherwise the best metal is laid on in leaf; the second best, in powder. A gold size is first printed with a block, and when it has dried to a proper tack, the leaf or powder, whether gold or metal, is applied. The gold, however, is generally too much alloyed to stand long; and, in fact, the inferior sorts of gold paper are printed with alloys of copper not of gold, as may be detected by the application of sulphuric acid; the beauty of such papers quickly flies where gas is used. DUTCH METAL. A. A.

GOLD PURPLE. A rich and powerful, though not brilliant, colour, varying in degrees of transparency, and in hue from deep crimson to dark purple. As a pigment it is chiefly used by miniature painters, who find it very durable. It is the "purple powder of Cassius", consisting of 65 peroxide of tin and 28.35 of gold, which has been principally used for a long period to give the above shades of ruby to glass.

GOLD SIZE. A preparation used to enable gold leaf to adhere to wood, metal, or plaster. There are two sorts, namely oil, and water, size; the former applied to wood and metal, the latter to plaster ornament. Oil size is prepared in various ways, but the following is said to be the usual form: $\frac{1}{2}$ oz. red chalk, $\frac{1}{4}$ oz. plumbago, 40 drops of sweet oil, and three drachms of pure tallow, and as much pipeclay as will bring it to the required consistency. The best, however, is said to be made of boiled linseed oil and ochre. Water or parchment size is simply the best ordinary size, coloured with ochre to any tint required. GILDING. A. A.

GOLDSTONE (THOMAS), prior of Christchurch, Canterbury, 1449-68, finished the south-western tower, and erected the porch of the cathedral, as well as the chapel of the Virgin Mary, now called dean Neville's chapel.

Another **THOMAS GOLDSTONE**, prior 1495-1517, erected in conjunction with archbishop Morton 1486-1500 the central tower of the cathedral, called Bell Harry steeple; his work is indicated by a sculptured rebus expressive of his name; **BRITTON**, *Cant. Cath.*, 4to., London, 1821, p. 38; **WOOLNOTH**, *Cant. Cath.*, 4to., London, 1816.

GOLD YELLOW. An orange coloured pigment which, being the hydro-sulphuret of antimony, injures other pigments with which it may be combined. It does not dry well when mixed in oil, and is destroyed by the action of daylight.

GOLF or **GOUF**. A term used in Scotland, where 'gouffing foundations' means underpinning them.

GOLLANE or **DALLAN**. A term used in Ireland for a monumental memorial or boundary stone.

GOMAR or *Gambhari* wood, see **GMELENA**.

GOMARD (CHRISTOPHE) was engaged at S. Germain des Prés at Paris, as noticed in the following interesting statement: "la réparation la plus importante fut celle que nécessita, vers 1646, la réédification presque entière de l'église. Malgré toutes les restaurations qu'elle avait déjà subies, la voute de la croisée menaçait ruine, la nef était sans voute et couverte en tuiles, les piliers sans sculpture et sans ornements. Les murs furent entièrement rebâties en pierre, ainsi que le portail méridional, et ces travaux s'achevaient sous la direction ou d'après les dessins de Christophe Gomard, de Louis Leveau, de Daniel Gittard, de Servandoni, et de Chalgrin, qui en furent successivement les architectes"; *Souvenirs de Paris*, fol., Paris, 1836.

In 1819 the vaulting again cracked, and **GOMARD** rebuilt the walls and pillars from the foundations, except the towers which he destroyed.

GOMBERT (THOMAS FRANÇOIS JOSEPH), born 5 January 1725 at Lille, studied 1743-4 at Paris under Desvigny. He settled at Lille, where he rebuilt 1772 the mint erected 1685, and superintended 1781-91 the conversion of the Jesuit college (rebuilt 1740-65) into a military hospital, which was considered a magnificent work of its kind. As *inspecteur-général des ponts et chaussées* he erected the bridge at Nieppe over the Lys. The composition and details of the mansions erected by him in Lille, especially those for the families van der Cussen, de Nazières, and de Cardon de Montreuil, have been highly praised. He died 9 October 1801 at Roult near Lestrem. 112.

GOMEZ (ALVAR), who had been *aparejador* in the quarries at Olihuélas, was engaged with the same title instead of *maestro-mayor*, on the cathedral at Toledo; his name appears the first in the list of architects to that edifice, but he directed the execution 1418 of the principal front, and 1425 of the tower. 66.

GOMEZ (ANTONIO) was master of the works 1548 at BATALHA.

GOMEZ DE MORA (JUAN), son of the painter Juan Gomez, was nephew and pupil of F. de Mora, to whom he succeeded 11 February 1611 as *maestro-mayor* of the royal works, and for the remainder of his life was engaged at various times in directing the operations at Valsain, the Escorial, Aranjuez, the Alhambra, etc. His first great work was the plain church for the Augustinian nunnery 'de la Encarnacion' at Madrid, 9 June 1611-16, but modernized by V. Rodriguez. Still plainer was his church for the Franciscan monastery of S. Gil, commenced 1615 in the same town; he preserved the columns and doorway of the old parish church erected by L. de Vega; the whole was destroyed during the French occupation of Spain. He reformed and rebuilt 1617-19 the plaza-mayor at Madrid (the portion of the south side that was burnt 16 August 1790 was rebuilt from the design of J. de Villanueva); and the royal building called the Panaderia on the north side (this was burnt 1673 and built with an altered

façade by J. Donoso). Gomez designed the catafalques placed, on the death 1621 of Philip III, in the church of S. Geronimo del Paso, and that of S. Domingo el Real at Madrid; executed the great south façade (of a Doric order in pilasters) to the old alcazar now destroyed, in that town; built the tower and houses called the Campillo in the woods of the Escorial; continued at Aranjuez the offices commenced by J. de Herrera, whose style he imitated in the casa de Caballeros 1613-28; and made the design for the cathedral which Philip IV proposed 1624 to erect there. In the same town he built the church (of a Doric order) on the plan of a Latin cross for the Trinitarios Descalzos; the portal to the church of the nuns 'de Constantinopla', finished 1628, but now destroyed; the houses for the marquis de la Laguna in the plazuela de Santiago; and those of don R. de Herrera in the calle de Alcalá. At Salamanca he designed 1617 the church and college of the Jesuits, the defects in which are attributed to his coadjutor J. de Matos; and continued 1625 the colegio del Rey of the order of Santiago, commenced by R. Gil de Hontañón. He laid the first stone of the church, on an elliptical plan, for the nunnery (which he also designed) of the Bernardines at Alcalá de Henares; the front, commenced 1617, of the archbishop's palace in that city is also attributed to him, though it is probably the work of J. B. Monegro, who died 1621; the latter work, if not also the former one, being carried out by S. de la Plaza. Gomez made designs for parts of the college of the Jesuits in the same city, but it is doubtful if they were adopted; and the façade is considered by CEAN-BERMUDEZ to be the production of F. de Mora, who planned the church; this façade, however, is the work of Gomez, for it was executed by B. Diaz Arias, who finished it in 1625, in which year Gomez designed the portal, constructed by Cristobal de Zumarresta, for the celebrated church at Renteria in Guipuzcoa. He decided 1628 in favour of continuing the octava of the cathedral at Toledo on the designs of N. de Vergara the younger, rather than on those of his successors Monegro and Theotocopuli; and would then appear to have retired from all but official employment. The date of his death is not known; he was alive 1645, but his heirs are mentioned in February 1648. 66.

GOMEZ SEPTIER (FRANCISCO), see **SEPTIER** (F. G.).

GONDOIN, frequently written **GONDOVIN** (JACQUES), born 7 June 1737 at S. Ouen-sur-Seine, was a pupil of J. F. Blondel. Having obtained the second prize at the academy, he (through the interest obtained in consequence of his being a son of the royal gardener at Choisy-le-Roi) was sent for four years to Rome. On his return to Paris he was employed by some friends and by the *directeur des postes*, through whom he obtained the commission 1769 to erect the école de chirurgie, now the école de médecine, which French writers consider the most classic work produced in Paris during the eighteenth century. He published *Description des écoles de Chirurgie*, fol., Paris, 1780. The king laid the first stone 1774, and in that year Gondoin was elected a member of the Academy of Architecture. A successful career of private practice enabled him to make another visit to Italy, and on his return he began to build for himself a house called Eaux-vives, in imitation of an Italian villa. His occupation as his own gardener carried him safely through the first part of the revolutionary period; he was named 1795 one of the members of the Académie des Beaux Arts; and became a member of the conseil des bâtiments. In 1805-6 he designed in the place de l'école de Médecine a fountain, which was converted 1836 into the entrance to the hospice des cliniques by A. de Gisors, who at the same time restored the école. The entrance is given in **NORMAND**, *Paris Moderne*, 4to., Paris, 1837, ii, 60; and the école, ii, 122-4; the plan of the entrance is given in **GOURLIER**, *Choix*, fol., Paris, 1850, ii, 249-50; who also, i, 155-6, shows the Colonne de la Grande Armée, erected 1806-10, in the place Vendôme in conjunction with Lepère, by Gondoin. He died 29 December 1818. **QUATREMÈRE DE QUINCY**, *Notice*, 8vo., Paris, 1824.

GONGE. The Anglo-Saxon term for a privy.

GONIOMETER. An instrument for taking the angles contained by the outlines of objects. A 'goniometron' invented by G. EARL for obtaining the leading lines of a building before sketching, is explained in the *MECHANICS' MAGAZINE*; the *PICTORIAL TIMES*; and the *CIVIL ENGINEER Journal*, 1846, ix, 369. 'An artist's goniometer' for obtaining correct representations of objects from nature, by pointing out their different angles, is described by H. TWING, in the *Transactions*, Royal Institute of British Architects, 21 February 1853.

GONSALVEZ (JOÃO) was commissioned about 1517 to erect one of the chapels at Belem. 88.

GONSALVO (SAN), and GONSALVO (SAN PIETRO), with SAN LORENZO, are mentioned by MILIZIA on the authority of FELIBIEN, as three architects of the Dominican order about the thirteenth century in Portugal. The first erected at his native place, Amaranto, a bridge, and a church which was afterwards dedicated to him: the second constructed at his native place, Tui, a stone bridge: and the third a bridge at Cavez. Of these, STUART, *Dict.*, and GWILT, *Encyc.*, have mentioned, evidently erroneously, only S. Gonsalvo and S. Pietro as building respectively the bridges at Tui and Carez (*sic*).

GONTARD (KARL VON), born 1738 at Mannheim, was a pupil at Bayreuth of Sempier and Richter, and was sent to study under Blondel at Paris, by the margrave, with whom he afterwards travelled in Italy, Sicily, and Greece. On the death of his patron he settled 1765 at Potsdam, and obtained the rank of royal architect and colonel. He superintended the construction of the palace called Sans-souci, and the greater part of the buildings erected by command of the king until 1778. At Berlin he designed the Spital bridge; the bridge of four arches of red sandstone adjoining the Königsthor (with G. F. Boumann); the two towers 1780 of the French church (designed by L. Cayart), in the Friedrichs-stadtschermarkt; and several private houses, which were built at the king's expense. He died 1802. NICOLAI, *Beschreibung*, 8vo., Berlin, 1786, i, 202, ii, 31.

GONZALES DE LARA (FERNANDO or HERNAN), the grandfather of A. Bcerra, practised at Toledo, where he commenced 1542 the foundations of the church for the hospital of S. Juan Bautista or de Afuera, designed by B. Bustamente, and continued the works at that establishment until his death, when he was succeeded by N. Vergara the younger. He continued the construction of the church of the Minims designed by A. de Covarrubias, but completed by M. Lopez; and undertook 1550 for 9,000 ducats (about £10,000) the construction of part of the arcades designed by the same architect for the Alcazar. The rest was worked by F. de Villalpando and G. de Vega before 1567. He succeeded Covarrubias as maestro mayor of the cathedral 1 October 1566, and died 31 August 1576. 66.

Another architect of the same name executed 1783, from the design of V. Rodriguez, the casas consistoriales at Burgos. 66.

GONZALES (MANUEL REGUERA), see REGUERA GONZALES (MANURI).

GONZALES VELASQUEZ (ALEJANDRO), born 27 Feb. 1719 at Madrid, was a son of the sculptor Pablo; became a clever painter; and, having studied under Bonavia, executed the church of S. Antonio from his master's design. His own works, such as the renovation of the church of the Vallica nunnery at Madrid, and the church of the Justinian nuns at Cuenca, were less important (although free from the faults of the Churrigueresque style) than his lectures as professor and vice-president, during twenty years in the Academy, in which he taught the merits of picturesque architecture. He died 21 Jan. 1772. 66.

His son ANTONIO settled in Mexico, where he was in practice 1800 as an architect, and was president of the Academy of S. Carlos. 112.

GOOD (JOSEPH HENRY), the eldest son of the late Rev. Joseph Good, rector of Sambrook, Somersetshire, was

born 18 November 1775. From 1795 to 1799 he was a pupil of Sir J. Soane. In 1803 he gained the first and second premiums (£200 and £150) in the competition for the alterations consequent on the Houses of Parliament in Dublin being occupied by the bank of Ireland; 1810 obtained in conjunction with W. C. Lochner, the first premium (£200) for a design for Bethlehem hospital, S. George's-fields: about 1814 was appointed surveyor to the trustees of the Thavie estate, Holborn: in 1818 designed the decoration and rearrangement of the interior of S. Andrew's church: became surveyor to the parish of S. Andrew, erecting 1823 the vestry hall, 1830 the national school, and 1831 the workhouse, in Shoe-lane: about 1819 succeeded W. Creswell as surveyor to the Worshipful Company of Armourers and Braziers, erecting 1840 the new hall in Coleman-street: and was surveyor to the Hope Assurance Company for many years until its dissolution in 1843. He designed and executed 1821-8 several works for the late Sir William Knighton, Bart., erecting a mansion for him at Horndean, Hampshire: built several villa and other residences and parsonage houses in different parts of England: and 1821 Appscourt park, Surrey, for John Hambrough, Esq. About 1822 he succeeded J. Nash as architect to the royal pavilion at Brighton, and from 1830 to 1837, during the reign of William IV, he erected several buildings at that palace, including the north and south lodges and entrances, an additional range of stables and coach houses, a dormitory, etc.; other buildings were designed by him and approved by the king, but not carried into execution. In 1826 he succeeded E. Mawley as architect to the Commissioners for Building New Churches, and on the abolition of the Commission 1 January 1857 a pension was granted to him. In 1830 he was appointed clerk of the works under the Office of Works and Public Buildings, to the Tower, Royal Mint, Fleet and King's Bench prisons, etc.; and shortly afterwards, on the death of T. F. Hunt 4 January 1831, he succeeded to that of Kensington palace, etc., and in the official residence on Palace Green; the appointment of clerks of the works having been abolished in 1832, the Office claimed possession of the residence, but by the king's permission he occupied it until his decease, 20 November 1857, in the eighty-second year of his age: he was buried in Kensal Green cemetery. He was one of the original Fellows of the Royal Instit. of Brit. Architects. Amongst his pupils were Robert Wallace; Henry Ashton; and Alfred Bartholomew. His eldest son Joseph Henry Good, F.R.I.B.A., is district surveyor in the metropolitan districts of Stratford le Bow and Poplar. J. H. G.

GOODWILL. The vendor of an established business frequently undertakes to introduce the purchaser into the connection which may have been formed by him; and this introduction is called the goodwill of the business. In Paris the profits to be derived from the habitual frequenters of a café are valued at so many months purchase, and their certainty is taken as an item in calculating the amount of goodwill. Another branch of goodwill is an undertaking by the vendor not to recommence the same description of business within a certain time or distance from the sale or place; but the limits must be very reasonable indeed to induce the courts to interfere for the protection of the purchaser in case of a breach of such a covenant. The term goodwill has acquired a wider scope of signification in England, being also applied to that item, of claim for compensation under compulsory sale, which expresses any advantage that the vendor may have in carrying on his business in the locality from which he is to be removed: under this item twelve or eighteen months net profits are generally demanded. COMPENSATION.

GOODWIN (FRANCIS), born 23 May 1784 at King's Lynn, Norfolk, was a pupil of J. Coxedge of Kensington. His designs are chiefly in the Pointed style; as Holy Trinity church, Bordesley, Birmingham, 1820-3 of Bath stone, costing £14,235; GENTLEMAN'S MAGAZINE, xlvii, 1827, pt. ii, 201; 1822-4 the church at Hulme near Manchester; that at Ashton-under-

Lyne; 1821 chapel of ease at Portsea, Hampshire; a church at Derby; 1821-4 at Kidderminster, for 2,000 persons; 1825 at Oldham; 1821 at West Bromwich, 130 ft. long by 56 ft. wide, with tower 114 ft. high; at Bilston; 1830 (?) at Walsall, Staffordshire, given in Tress, *Working Drawings of Churches*, 4to., 1841; and 1823 at Burton-on-Trent, Staffordshire. He also rebuilt the old churches at Bilston, and at Walsall; and S. Michael's, Southampton; the tower of S. Peter's, Manchester; and that of S. Paul's, Birmingham. He erected the markets at Leeds; and 1825 at Salford, Manchester: the exchange at Bradford; 1822-4 the town hall and assembly rooms at Manchester, his *chef-d'œuvre* at least as regards the interior, of which a description is given in his *Rural Arch.*, vol. ii, 2nd edit., 1835; 1823-4 the town hall and assembly room at Macclesfield; and 1824 the county prison at Derby. He completed 1823 for the completion of King's college, Cambridge, for which he sent a classic and a Gothic design; submitted plans about 1822 for rebuilding parts of Magdalen college, Oxford; completed 1828 for the Middlesex lunatic asylum; obtained 1830 a premium in that for the grammar school at Birmingham; and publicly exhibited a series of drawings of a scheme for an extensive cemetery in the vicinity of the metropolis, the buildings being designed after the best examples at Athens. Many of the drawings for the above works were exhibited at the Royal Academy of Arts in London, which in 1834 also contained a design for the "intended suspension bridge at Horseferry-road, projected by Capt. S. Browne, R.N., and F. Goodwin, architect and engineer—and approved by the provisional committee"; and a design for 'a national Pantheon' in Trafalgar-square.

Among his private works were Lissadell, in the county of Sligo, Ireland, for Sir R. G. Booth, Bart., with the park entrance, given in *Dom. Arch.*, 1st and 2nd ser.; lodge for G. Dodwell, Esq., Sligo; works for E. J. Cooper, Esq., M.P., at Markree, in the same county; and others for Lord Hatherton in Staffordshire. In 1834 he was at Belfast engaged in preparing designs for extensive additions to the college, including a large museum; and others for baths at Dublin, but these were not executed.

He published *Plans, etc., of the New House of Commons*, fol., London, 1833, being sketches submitted to the Committee of the House, and printed by their order; these designs are said to have been the best of those sent in by the witnesses examined; *Domestic Architecture*, 4to., 1833; *Rural Architecture, designs in various styles*, 4to., 1833; *Cottages, Lodges, Dairy Farm Houses, etc.*, 4to., 1835, as supplement to the latter work; *Domestic Architecture, a second series of Designs for Cottages, Lodges, etc., with Observations on the English Domestic style*, by W. H. LEEDS, 4to., 1834; a Supplement to *Cottage Architecture*, 4to., 1835; and *Rural Architecture, designs in various styles*, 1st and 2nd series, 2nd edit., 2 vols. 4to., 1835. He died of apoplexy 30 August 1835, while engaged on a set of designs for the new Houses of Parliament; and was buried in the Kensal-green cemetery. Benjamin Baud was a pupil. Memoir in *LOUDBON, Arch. Mag.*, 8vo., London, 1835, ii, 476; and review, i, 132-6; *GENTLEMAN'S MAGAZINE*, new series, iv, 659.

GOOMLI. A city, formerly the capital of the Jaitwas, situated about three miles from Bhanwul in the peninsula of Gujerat in Hindostan. It was founded 693, and deserted about 1053 or 1063; but it still possesses, besides the Ramghol (gate of Rama) which has pointed arches, three temples, each of which is mentioned as remarkable for some peculiarity in design by TOD, *Travels*, 4to., London, 1839, p. 404-19.

GOORNEH, GOURNEH, GOURNEI, or KOORNEH. The village, on the west bank of the Nile, occupying the site of the ancient Libyan suburb of THEBES, in Egypt.

GOOSE YARD. Geese require the same sort of accommodation as is provided in a well-arranged DUCK-HOUSE. The ancient arrangements are mentioned s. c. CHENOBOSCEUM. No such trouble is taken with these birds at present; in Lincoln-

shire, during the breeding season the birds, kept for the sake of their feathers, are taken twice a day to water, and driven back to the house of their owner, where each is lifted into its separate lodge in one of three tiers of wicker pens set in each room, even in the bed rooms.

GOPURA (Fr. *covera* and *covan*). The Indian name for a gate-tower in the wall enclosing the space of ground in which are the cell and porch forming a temple in the south of Hindostan. In elevation, it is pyramidal like a pagoda; but instead of being square like the temple in plan, the gopura is merely a pylon sometimes 130 ft. wide by 100 ft. deep, pierced in the middle of the longer sides by a gateway which occupies a seventh, or even a fourth of the width of the tower. The pile is covered by a crested roof resembling a boat with the keel uppermost, so as to imitate as much as possible the domical covering of the pagoda. The top story is called by French writers *varangue*. The longer the wall in which the gopura is placed, the larger is the gateway and the tower: consequently, when a temple has more than one enclosure, the external gopuras are the largest. This rule renders the erection of an additional wall a matter of great expense, as four gateways are required for each enclosure, except in the case of that nearest to the pagoda, where they are only required at the front and at the rear of the temple. The base, though decorated in two stories, is generally solid, except the gateway with a recess on each side of it, and the staircase leading to the upper stories. Among the finest gopurals are those at SÉRINGAM, seventeen in number; at Combaconum, shewn in FERGUSON, *Illust. Handbook*, 8vo., London, 1855, i, 93; and at CHILLAMBARAM, given as dating about 990-1004 in *Pict. Illustrations*, fol., London, 1847, pl. 22, by the same author, who notices that this example exhibits a peculiarity in the brick pavilions put on each side of the entrance to cover the statues of two giants meant to represent *dwarpalas* or porters, and is perhaps the only solution of the intention of a projection seen in the necessary place on all other gopuras.

GORDONIA. The variety of this tree, called *bonjam* in Gualpara in Hindostan, is chiefly used by turners: that called *kaza* in Martaban, is a large tree used as timber for ordinary purposes in buildings; it weighs about 37 lbs. 10 oz. per cubic foot. 71.

GORE. This term, used in Yorkshire to express the lowest portion in a tract of country, is said to occur with the same meaning in every language from the Ganges to the Shannon; *ARCHÆOLOGIA*, xvii, 146.

GORGE. This term, as used by French architects and adopted by English writers, has led to much seeming discrepancy in professional books. It properly means a shallow molding somewhat like a scotia, or the section of an elliptic flute: but even in France it has been used instead of cymatium, whence it has been translated by *cavetto* and cyma-recta. 1. 2.

The *gorge* of a chimney-piece and of a door means, in old French books, the frieze or substitute for a frieze between the architrave and the cornice over the opening.

GORGERIN. The diminutive of the above, is equivalent to *collarino* and *hypotrachelium*. GULA. 5. 25.

GORGONS. The three daughters of Phorcys and Ceto. The hair of one of them, Medusa, was changed into serpents; and her head having been cut off by Perseus, the blood turned into snakes: such is the general type of the Gorgoneia (Gr. γοργόνεια), which are masks, sometimes beautiful, sometimes terrible and repulsive, used in friezes and on keystones; and which appear on the ægis worn by a deity. 2. 6.

GORGONZOLA (PIETRO DA) appears under the date 1491 in the list of architects employed on the cathedral at Milan. 27.

GORON or GOROME. A term used in the Mediæval period, probably for what are now called dowels or cramps. The following items occur; 1332, twelve *goromis*; 1333-7, six small *goromis* of iron, at $\frac{1}{2}$ d. each; 1351, eighteen cramps and *gorons*,

at 2d. per lb.; 1352, for 44 *gorons* for the finials above the chapel, 2s. 6½d.; for 32 large *gorons* for the finials, 6s. 5½d.; used in strengthening of several stones on the top of the chapel, with *gorons* and cramps of lead, six wagers (1092 lbs.) of lead; four *gorons* made for holding the upper stones upon the great pinnacles of the chapel, weight 33 lbs., 5s. 6d.; BRAYLEY and BRITTON, *Palace of Westminster*, 8vo., London, 1836, pp. 155, 159, 165, 167, 169. GUDGEON.

GOROSTIAGA (JUAN ORTIZ DE), see ORTIZ.

GORSEDE. The Welsh name for the mount from which justice was dispensed to the surrounding ecclesiastical tenantry, according to LEDWICH, *Statistical Account of Aghaboe*, 8vo., Dublin, 1796, p. 93.

GORTYNA or GORTYN. A city, on the banks of the Lethæus in Crete, which is now represented by a village called Agios Deka. Near the ruins of the cathedral are those of a church of the Hospitalers. The places of one row of thirteen ECHELA are shewn in the plan of the larger theatre, given in FALKNER, *Museum*, 8vo., London, 1854, ii, 277-86, translating the information recorded by BELLI, 1582-96, upon the remains of ancient buildings: FALKNER, *Supplement*, p. 20, mentions a list of edifices which may be compared with the accounts given in TOURNEFORT, *Voyage*, 4to., Paris, 1717, p. 58-64; POCOCKE, *Description of the East*, fol., London, 1743, b. 2, i, 252-5; SAVARY, *Lettres sur la Grèce*, 8vo., Paris, 1788, p. 201-28; and SIEBER, *Reise*, 8vo., Sorau, 1823, i, 506-20.

GORTYNA or GORTYS. A ruined city of Arcadia in Greece. The plan and gate have been illustrated by DODWELL, *Cyclopean Remains*, fol., London, 1834; BLOUNT, *Morée*, fol., Paris, 1826-31; LEAKE, *Morée*, 8vo., 1830, ii, 25.

GORZE (ANSTEUS OF). A monk of the tenth century who seems to have enjoyed considerable reputation, though said to have had but few opportunities of exercising his talents; WHITTINGTON, *Survey*, 8vo., London, 1811, 44; LE BEUF, *Recueil*, 12mo., Paris, 1738, ii, 139.

GOSLAR. An old city, surrounded by lofty walls, in Hanover. The cathedral, founded 1050, was pulled down 1820 except the porch of the front, which was converted into a museum containing some remnants of glass dating in the fourteenth century. There are three churches; the Klosterkirche is a plain Romanesque building with pointed vaulting and a remarkable exterior to the apse; a granary which is part of the Kaiserpfalz or imperial palace; a town hall of the fifteenth century; a guild's hall, now an hotel; a poorhouse; and a few old dwellings which escaped the fire 1780. 28. 50.

GOSPEL SIDE OF A CHURCH. The left hand side of a person looking from the nave to the chancel; where ORIENTATION has been observed, this is the north side of the church: the reverse is noticed as an exceptional case in the cathedral at Sens by THIERS, *Diss.*, 8vo., Paris, 1688. The use of the words *right* and *left*, in speaking of a church, has caused great confusion; thus in the *Annales de Philosophie Chrétienne*, 8vo., Paris, 1840, xix, 430, the phrase *left of nave* is used for south. BATTISIER, *Hist. de l'Art*, 8vo., Paris, 1848, p. 368, confesses that critics do not know which is meant by the right and the left in the early descriptions of the basilicas; he inclines to the opinion that the right hand meant the south, but acknowledges that the question has not been solved. Even in the not-orientated church of S. Clemente at Rome the gospel ambo is to the south, *i. e.* to the left hand on entering the church, and has the paschal candlestick attached to it at the end nearest the door: the situation of the candlestick attached to the gospel ambo in the church of S. Lorenzo fuori delle Mura is a silent evidence that, when the sacrum was moved from one end to the other by pope Honorius III (1216-27), the two ambones were suffered to remain in their old position; and that there, as still in S. Clemente, the gospel ambo was originally south.

GOSSE (MICHEL) is supposed to have designed 1218-38 the church of the Virgin at Etretat; COMITÉ HISTORIQUE, *Bulletin*, 8vo., Paris, 1843, ii, 575.

GOSTANTINO, see SERVI (CONSTANTINO DE').

GOTHENBURG or GOTTENBURG (in Swedish Göteborg). A seaport city on the river Gotha or Göta in Sweden. It is intersected by canals having well paved quays planted with trees and bordered by houses of brick faced with stucco or with stone. The chief buildings are the cathedral; two churches, one, the Swedish, having a dome; the episcopal palace; the governor's palace; the town-hall; the exchange, in course of construction 1848; the theatre; the barrack; several educational institutions and hospitals; and the porter, sugar, and tobacco factories. The export trade in battens has existed here for a long period; thus on 21 January 1628 one hundred marks were paid "to James Bannatyne for his panes taken in bringing hame the tymbre from Gottinberrie" for building Heriot's hospital, Edinburgh; Extracts from Minutes of the Governors, given in *Transactions of the Arch. Inst. of Scotland*, 8vo., Edinb., 1852, ii, 30. 50.

Gottenburg red deals and battens, best, seconds, and thirds; mixed white; and mixed red boards, are sold in the English timber markets at the present day.

GOTHIC ARCHITECTURE. The name commonly though improperly applied to the phases of Pointed art that prevailed in great part of Europe from the thirteenth to the sixteenth centuries. The length of time during which this term has been so accepted would render its disuse inconvenient, and it is therefore here noticed in the light of a conventional designation, although the COMITÉ HISTORIQUE DES ARTS, etc., *Bulletin*, 8vo., Paris, 1844, ii, 739, remarks upon the following passage with regard to the abbey of Rolduc "sacerdos Albertus et frater Embrico jacentes (1107) fundamentum monasterii scemate (schemate) Longobardino", that "ce texte est d'une certaine importance, il facilitera peut-être la justification du terme de Gothique appliqué à l'architecture ogivale." This portion of the subject has been treated in DALLAWAY, *Discourses*, 8vo., London, 1833, p. 1-19, whose authorities cannot easily be verified. In considering the question whether or not any connection might be established between the Goths and Pointed art, it is necessary to remember, that the Goths after their migration from the gulf of Danzig to the south side of the Danube, separated into two branches; that the Ostrogoths were absorbed about 552 by the Eastern empire; and that the Visigoths were reduced about 711 from a power on each side of the Pyrenees to a monarchy in the Asturias. If the erection of any buildings can be ascribed to the sovereigns of a Gothic people, the Latinity of the tomb of Theodoric is scarcely to be doubted, but the churches erected before 1100 in Spain, as described by local authors, must be carefully investigated with regard to any distinction to be drawn between works executed there previous to 715 and buildings dating 715-1100. LLAGUNO, *Noticias*, 4to., Madrid, 1829, scarcely makes any other division than *gotico, gotico antiguo, estilo de los Godos*, or Romanesque, and *arquitectura Gotico-germanica*, or Pointed. Probably the only other notice of the existence of Gothic artists occurs in the remarkable passages in WILTHEIM, *Diptychon*, fol., Liège, 1659, app. 22, "Nam is qui acta S. Audoeni condidit, ita de basilica D. Petri Rothomagensi scripsit: Miro opere, quadris lapidibus, Gothica manu, a primo Clothario Francorum rege, olim nobiliter constructa fuit"; or in another version, "per manum Gothicam"; and in another, "ab artificibus Gothis"; A.D. 558-562; RAMÉE, *Manuel*, 12mo., Paris, 1843, ii, 116. It would appear possible that these artists might have been Ostrogoths educated by desire of Theodoric, but their school would seem to have expired, for Charlemagne obtained Byzantine artists for his works at Aix-la-Chapelle, unless it be supposed that the Byzantine court sent to him Ostrogoths educated under the influence of that special passion for fine architecture which is attributed to Theodoric, by GIBBON, *Decline*, ch. xxxix, A.D. 500.

It is probable that VASARI, *Vite*, who says "lavori che si chiamano Tedeschi—questa maniera fu trovata dai Goti", was

the source of the passages in which WORTON, *Elements*, fol., Lond., 1624, p. 51, ascribed the invention of the Pointed arch to the Goths and Lombards, and in which D'AVILER, *Dict.*, 4to., Paris, 1693, announced that the "architecture gothique, que les ouvriers appellent aussi moderne—est originaire du Nord, d'où les Goths l'ont introduite premièrement en Allemagne, et ensuite dans les autres parties de l'Europe." Similar sentiments are expressed by EVELYN, *Account of Archts.*, fol., London, 1706, 2nd edit., p. 9, who speaks of the faultless and accomplished buildings which would doubtless have still subsisted "had not the Goths, Vandals, and other barbarous nations, subverted and demolished them—introducing, in their stead, a certain fantastical and licentious manner of building, which we have since called modern (or Gothic rather)."

WREN, in the report 1713 upon Westminster abbey, *Parentalia*, fol., London, 1756, p. 297, spoke of the commencement made 1220 to rebuild it in "the mode, which came into fashion after the holy war. This we now call the Gothic manner of architecture, so the Italians called what was not after the Roman style"; though he also used the word Saracenic in reference to Pointed art: and the early Dictionaries of modern languages contain intimations of the use of the words Gothic architecture as meaning a style with two phases, the ancient and the modern, the heavy and the light (the Romanesque and the Pointed), which intervened between the classic and the neo-classic periods. MORONI, *Diz.*, xxxi, 301, notices "si distinsero le architettura Gotiche in fiorite, in greche, et in tedesche." MEDIEVAL ARCHITECTURE; POINTED ARCHITECTURE. EARLY ENGLISH, and other divisions of the style. GERMAN ARCHITECTURE, and the corresponding descriptions of the architecture of other countries.

GOTTWICK (JOHANN GEORG) was extensively engaged after 1656 at Prague, where he was shot 12 March 1684 by a drunken soldier, and buried in the church of S. Roch; *Annales Strahon.*, iii, s. a. 20. 68.

GOUDE (CORNELIS FREDERIKSZ VAN DER). The church of Gouda having been destroyed by fire 12 January 1552, it was begun to be rebuilt two months after, from Goude's plans and under his superintendence, at an annual salary of £20:10:0 Flemish (about eleven guineas of present money). He probably also rebuilt 1560 the tower of S. Martin's church at Tiel, an architect of Gouda having been employed; WALVIS, *Beschryving der Stadt Gouda*, 4to., Gouda, 1714, ii, 57. This is probably the FREDERIKS employed at Leeuwarden. 24.

GOUF, see GOLF.

GOUGE. A hollow chisel, semi-cylindrical in section, the end ground square across with a bazil like an ordinary side firmer. It is used by carpenters and joiners for making round holes, and cutting hollow grooves. The size varies in diameter from $\frac{1}{16}$ in. increasing by sixteenths up to an inch; then by eighths up to 2 ins., the largest usually sold. Small sized gouges have handles like ordinary chisels; the larger are generally made with socket handles. The gouges used by turners are usually ground to a rounded point, and are called 'parting tools'. The word gouge is probably derived from the French; MENAGE says from "guvia", which he states is "mot gaulois". CHISEL; FIRMER. A. A.

Wilson's 'patent cylindrical gouge' is said to effect a great saving when used in machines for planing, surfacing, squaring, and rounding timber.

GOUJON (JEAN), not GOUGEON, as it is often written, is styled architect to the constable de Montmorency and to Henry II, by MARTIN, *Vitruve*, fol., Paris, 1547, but has no building ascribed to him by BERTY, *Les grands Architectes*, 4to., Paris, 1860, who notices the tradition that he was shot 24 August 1572 while working at the Louvre, but adds that his name does not occur in the accounts for that palace after 1561-2. He was better known as a sculptor.

GOULET (NICOLAS), born 1745 at Paris, built and decorated many hôtels and houses in that city and its environs.

ARCH. PUB. SOC.

He published *Moyens d'éviter les incendies et d'économiser le bois dans la construction*; with *Inconvénients des fosses d'aisance*, etc., 8vo., Yverdon, 1785; reprinted with *Dissertation sur les murs des quais, etc., de Paris*; in *Observations sur les embellissemens de Paris*, etc., 8vo., Paris, 1808; and wrote the text to KRAFFT, *Recueil d'arch. civile, contenant les—châteaux, maisons de campagne, etc.—aux environs de Paris*, etc., fol., Paris, 1806-7, and 1812; to the third part of LEGRAND, *Description de Paris et de ses édifices*, 8vo., Paris, 1809; and to PERCIER, *Description des fêtes—du mariage de Napoléon*, 8vo., Paris, 1810. He was *architecte du cadastre adjoint* to the mairie of the 6^{me} arrondissement; member of the Legion of Honour, and of many academies and learned societies. He died at Paris in January 1820. 110.

GOUPY (. . .) designed the "Chinese temple or house of Confucius, built many years ago" at Kew (which must not be confused with the pagoda by Chambers); GENTLEMAN'S MAGAZINE, xliii, 1773, p. 281. He was probably the Joseph Gowpy who, in 1766, subscribed the roll of the Incorporated Artists; and may have been the Goupé, *architecte-juré expert*, who submitted a design in competition 1749-50 for a site for the statue of Louis XV, PATTE, *Monumens*, fol., Paris, 1765, p. 199, pl. 39. Some painters of this name are mentioned in WALPOLE, *Anec.*

GOUR or GAUR. The ancient capital of Bengal. It was deserted about 1603, when the Ganges forced a new channel for itself now about four miles from the town. The principal ruins are a brick mosque faced with black porphyry, about 170 ft. long and 130 ft. wide; a large building faced with bricks of various colours, containing a room 36 ft. square and about 45 ft. high; and two gates. Several other mosques; a Mahometan tower of Victory 84 ft. 6 ins. high, with stairs to its top; and the large tanks; are still in tolerable condition. DANIELL, *Oriental Scenery*, fol., London, 1795, i, pl. 4, gives one gate; and *Views*, 4to., 1805, shows the tower. 50.

GOURLIER (CHARLES PIERRE), born 15 May 1786 at Paris, was a pupil of Alavoine. He became an engraver, and published, with BIET, GRILLON, and TARDIET, *Choix d'édifices publics construits ou projetés en France, extraits des archives du conseil des bâtimens civils*, 3 vols., fol., Paris, 1825-50. He also wrote *Essai sur la construction des tuyaux de cheminée et autres*, 8vo., Paris, 1830; *Notice historique sur le service des travaux des bâtimens civils à Paris, etc.—depuis la création—en 1795*, 8vo., Paris, 1848; and *Des voies publiques et des habitations particulières à Paris*, 8vo., Paris, 1852. NORMAND, *Paris Moderne*, 4to., 1837-8, i, pl. 80-1, 107-9, gives, 1822 a house in the rue du Bac, No. 82; and 1833, another in the rue S. Denis, No. 303, as designed by Gourlier; who, besides being for fifteen years professor in the central School of Arts and Métiers, was 1824 inspecteur at the erection of the bourse, at the restoration of the porte S. Martin, and 1827 at the greniers de réserve. He was also inspecteur général; architecte diocésain; architecte des greniers de réserve; and rapporteur-secrétaire au conseil des bâtimens civils. He died at Paris 16 February 1857. 112.

GOUST (. . .) continued the design of his master Chalgrin for the arc de l'Etoile at Paris after the death of the latter 20 January 1811 until the stoppage of the work in 1813, when it was completed up to the impost of the great arch. It was continued by him from 1823 to his death in 1828, in which time it had been carried up to the first course of the architrave; GOURLIER, etc., *Choix d'édifices*, fol., Paris, 1825-50, ii, 242-7.

GOUT, GOIT, or GOWT. This term is generally explained a drain. It is still retained in use in Lincolnshire, not merely in that sense, but also as applied to the sliding door at the extremity of a drain, by means of which the water is retained in it in a dry season, and let off in a time of flood; *Journal of the Archaeological Association*, 8vo., London, 1849, iv, 21. The word may probably be derived from the Fr. *égout*, a drain or sewer.

GOWAN. This term properly means decomposed granite, but is sometimes applied to the solid rock. 23.

GOW EL KEBIER, in Egypt, see ANTÆOPOLIS.

GOWER (EDWARD) was clerk of the works at the manor and park of "Claryngdon" in Wiltshire, appointed by letters patent 5 November 1460, 1 Edward IV, and was excluded by the Act of revocation 4 Edward IV; *Rolls of Parliament*, v, 544 b.

GOWER (JOHN). The traditional name of this master mason is contained in the vernacular rhyme of

"John Gower,
Who built Campden church and Glo'ster towre",

as given by DALLAWAY, *Discourses*, 8vo., London, 1833, 178; the tower was built 1456-69; BRITTON, *Gloucester Cath.*, 4to., London, 1835, 72, says he "completed the choir"; and CARTER, *Ancient Sculpture*, fol., London, 1780, i, 53, states that the curious 'mason's square', attached to the east wall of the south transept, is traditionally assigned to this person. It has two small figures as supports, one supposed to be the master mason with tools in his apron, and the other the apprentice with arms extended, both in the costume of the period. FOSBROKE, *Gloucester*, fol., London, 1819, p. 127.

GOWN. A tunic, robe, or gown, appears to have been a common reward in the Middle Ages given to dependents and retainers; and to have formed part of the remuneration to the workmen, and even to the master workmen, in the mediæval period; it is shown worn by them in the representations in glass, etc. The master mason at Ely, 1321-49, had a fur robe to cost 15s. 3d., in addition to his stipend, rent, board, and wages. The first donation of cloth for a livery to the clerk of the works of the king's household, yet ascertained, was in 1391-5, the recipient being John Gedney: this gift was continued even to Inigo Jones, but was withdrawn soon afterwards. At the burial of Edward VI, the surveyor of the king's works had seven yards of cloth, and each of his three servants three yards. H. Flitcroft was to receive "all liveries, vestures of furs, wool, and skins to the office belonging" of comptroller of the Board of Works, 10 March 1758. It is still retained by the corporation of London, whose architect, formerly called clerk of the works, appears on state occasions in a livery gown of black silk.

The custom may have been followed in foreign parts, but the only notice occurring is that of a party coloured gown given to Perrin, the mason at Bourg-en-Bresse in Burgundy, about 1520; BAUX, *Notice, etc., de N. D. de Bourg*, 8vo., Bourg, 1849, p. 54.

CHAUCER, *Canterbury Tales* (The Sompnore's tale), edit. WRIGHT, 8vo., 1847, line 7829; BROWNE, *York Cath.*, 4to., London, 1837-49; SURTEES SOCIETY, *Fabrick Rolls of York Cath.*, 8vo., Durham, 1859; BENTHAM, *Ely Cath.*, 4to., Norwich, 1812; and Suppl., 1817; SCOTT and others, *Gleanings from Westm. Abbey*, 8vo., London, 1861; *Transactions*, Royal Institute of British Architects, 1859-60, p. 22, and 1861-2, pp. 42, 44, etc.; *A Brief Account of Durham* (RAINE), 8vo., Durham, 1833; SURTEES SOCIETY, *Durham, Script. Tres.*, 8vo., Newcastle, 1839; App., clxxx, and cclxxiii; RAINE, *Catterick Church*, 4to., Lond., 1834, and ARCHÆOLOGICAL JOURNAL, 1850, vii, 56-9; MAYLAND, *London*, edit. ENTICK, fol., 1756, i, 152; GARDNER, *Hist. of Dunwich*, 4to., London, 1754, p. 145; and NICHOLS, *Illustrations of Manners*, etc., 4to., London, 1797, p. 183-9-90; GAGE, in ARCHÆOLOGIA, 1831, xxiii, 327-33; TIGHE and DAVIS, *Windsor*, 8vo., London, 1858, i, 375; and *Wardrobe Account of 13 Henry VI*, Addit. MSS. 17,721, in the British Museum. GLOVE; WORKMAN.

GOY (AUGUSTE), born 1793 at Melun (Seine et Marne), was a pupil of Alavoine. He was architect to the departments of the Seine and Oise. In 1822 he built the maison d'arrêt at Versailles, given under date of 1828 in GOURLIER, etc., *Choix d'édifices*, fol., Paris, 1825-50, ii, pl. 118; 1825-6, the works of the cattle market at Poissy for the supply of Paris; 1827,

the entire restoration of the bishop's palace; 1828, the erection of a tribunal of commerce, both at Versailles; and 1829, that of the chapel of the maison centrale at Poissy. He had prepared designs for the great seminary at Versailles; the entire restoration of the cathedral; that of the church of S. Louis at Poissy, and the enlargement of the cattle market at the same place. The date of his death is not known. 110.

GOYAZ, in Brazil, see VILLA BOA DE GOYAZ.

GOYTI (FELIPE LAZARO) completed 1653 the *ochava* or octagonal portion of the Lady chapel in the cathedral at Toledo, having succeeded 13 August 1643, L. Fernandez de Salazar as maestro mayor. He died 17 August 1653. His brother PEDRO LAZARO was in practice 1660 at Madrid. 66.

GOZZO (GIACOMO DA), see FERRARA (G. DA).

GRAAF (CORNELIS MAARTENZ DE) was engaged at an annual salary of 300 florins (£25) to design and erect the tower of the church at Schoonhoven in Holland: on the completion 1647 of the work, the salary became a pension; VAN BERKUM, *Besch. der Schoonhoven*, 4to., Gouda, 1762, p. 403. 24.

GRADIENT, properly written *gradient rate*, is the amount of proclivity of an inclined plane used as a path or road. In forming approaches the amount of practicable gradient is best decided by reference to existing examples.

| | The Gradient is One in |
|---|------------------------|
| S. James's-street, at 660 ft. from Piccadilly - | - 27 |
| Haymarket, at 490 ft. from Piccadilly - | - 22 |
| Southampton-street, from the Strand - | - 19 |
| Fleet-street, opposite Salisbury Court - | - 42½ |
| Ludgate-hill, ending at S. Paul's Church Yard - | - 25 |
| Holborn-hill, it varies from - | - 16½ to 23 |
| Skinner-street - | - 24 to 29 |
| The ends of old Westminster bridge were - | - 22 or 23 |
| " " originally - | - 15 |
| Blackfriars bridge - | - 24 or 25 |
| " " originally - | - 16 |
| Vauxhall bridge - | - 35 |
| Approach to Waterloo bridge, Surrey side - | - 31 |
| " Southwark bridge, Middlesex side - | - 22 |
| Charing Cross, from Craig's Court to the Statue (about 230 ft.) - | - 27 |
| " towards Whitehall - | - 37 |
| Strand, between Craven-street and Hungerford Market (100 ft.) - | - 34 |
| Waterloo-place, between Pall Mall and Charles-street (330 ft.) - | - 35 |
| " ending at Piccadilly - | - 25 |
| Regent-street, between Piccadilly and County Fire Office - | - 42 |
| Conduit-street, above Mill-street - | - 42 |
| New Westminster bridge, the approach (as designed) from Middlesex side - | - 57 |
| " " Surrey side - | - 54 |
| " " and to the centre - | - 75 to 362 |
| Telford regarded the limit of a hill for a stage coach and trotting horses as - | - 32 |

BUILDER JOURNAL, xvii, 214; and CIVIL ENGINEER JOURNAL, v, 200. The above may now be checked by, and others obtained from, the Ordnance Survey.

The Administration des Ponts et Chaussées admits the limit of 1 in 33½ for the inclination of a route royale, and 1 in 20 for a chemin vicinal de grande communication.

A table of gradients from 1 in 10 to 1 in 330, showing the rise per mile in feet from 528 to 16, is given in HASKOLL, *Railway Guide*, 8vo., London, 1848, ii, 185.

GRADUATED STAGES, see ISACOUSTIC CURVE.

GRADUS. This Latin word, meaning a man's step on level ground, was applied to the step of a stair and to the round of a ladder; also to a series of such steps or rounds; and later not only to any division of a series, but to the series itself, and to the surface on which the division is made, so that even an avenue has been called *gradus*. Amongst the uses of the term by late Latin authors may be noticed its application to the AMBO, and the SCALA SANCTA. The Will of Henry VI, given in NICHOLS, *Collection*, 4to., Lond., 1780, p. 297, mentions "six greces (steps, gressus) to be before the high altar with the grece called *gradus chori*"; and, p. 302, shows that the *gradus chori* meant the ascent from the choir to the sacrum. GRE.

GRÆCANICUM OPUS. The name given by PLINY, H. N., xxxvi, 63, to the sorts of pavements described by him,

though his description is by no means clear. He seems to say that formerly in Italy the pavements were rude and under cover, and that the Greeks first invented *subdialia* or out door pavements; these being of two kinds, one for roofs, etc., placed on boarded floors, and one on rammed earth. The directions of VITRUVIUS, vii, 1, as to their execution, tally almost exactly with those of PLINY, and with modern usages. He says that a rough concrete containing one-third or two-fifths of lime was well rolled and beaten down; on this a second coat (*nucleus*) was placed, being no doubt the finer sort of concrete as used now in Italy; a fall of 1½ in. to 2 ins. in 10 ft. was prepared to carry off the water; and the surface was rubbed with a polishing stone or hone. PLINY adds that if the pavement has a coat of pounded charcoal, sand, lime, and ashes, and is then polished, it will look like black marble; or it may be finished with 24 in. tiles; or it may be *lithostrota*; or it may be covered, as VITRUVIUS states, with pavements of cut work (*sectilia*) probably marble, or with *tesserae*, or with *testacea spicata*. Concrete polished to look like black marble is a usual pavement for terrace walks at present in Italy; and flats covered with foot tiles are in frequent use. The *lithostrota* or "strewn with stones", which PLINY says are composed "parvulis certe crustis", is no doubt the present pavement called in Italy "pavimento Veneziano", which is made thus. When the upper coat of concrete is wet a number of small broken pieces of marble of all sorts and colours are strewn over it, beaten into it, and rolled down solidly with a heavy roller. The whole surface then is sanded and polished, and presents a sort of marble conglomerate very pleasing to the eye. On these concrete pavements *mosaics* (*musivum opus*) are bedded. In Roman mosaic any flat surfaces of the same tint are executed by numerous small squares set side by side. In the Florentine, the same thing is done by one single piece of the required size and shape. It is not improbable, therefore, this is what is described by VITRUVIUS as *sectilibus*, as contradistinguished from *tesseris*. *Testacea spicata* are described by VITRUVIUS as "not having hollows, or rising surfaces, but as rubbed down to a rule" (level). This expression has puzzled most editors; BALDUS and PHILANDER supposing it to be that described above as LITHOSTROTA or "pavimento Veneziano"; but from some examples at Rome and the villa of Hadrian at Tivoli, the editors of the Elzevir folio variorum edition of VITRUVIUS, fol., Amst., 1649, have considered it to be a tile pavement, the design and shading of which would lead the eye to suppose it was herringboned work, having the ridges formed by alternate light and dark sides.

A. A.

The term (the "opus græcum or rather græcanicum" of HOPE, *Historical Essay*, 8vo., London, 1840, i, 147-52) has also been applied to two of the divisions into which mosaic work has been separated by WYATT, *Specimens*, fol., London, 1848, who does not appear to have had any better authority than HOPE, p. 147, for using it, and who, p. 10, calls the insertion of coloured *marble tesserae* in white marble flags opus Alexandrinum or Græcanicum; while p. 10 and 15, he applies Græcanicum as an epithet peculiar to the insertion of coloured glass tesserae in white marble flags. As opus Alexandrinum is now understood to mean work altogether of marble, it would save confusion if the marble work mixed with glass tesserae were known as opus græcum, not græcanicum.

GRÆCOSTASIS. The name of a building, in the forum at Rome, used either as a hall of audience, or as a dwelling, for ambassadors. There is an uncertainty as to the appropriation of the edifice, as well as to its exact locality, although both of them would seem to be explained like the origin of the name in the following passage from VARRO, *L. L.*, 8vo., Gottingen, 1833, p. 61: "Ante hanc (i. e. Curiam Hostilium) Rostra quous loci id vocabulum quod ex hostibus capta fixa sunt rostra: sub dextra huius Comitio locum substructus ubi nationum subsisterent legati qui ad senatum essent missi; is Græcostasis appellatur a parte ut multa: senaculum supra

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græcostasim ubi ædis Concordiæ et basilica Opimia"; but antiquaries are not agreed as to the exact locality of any one of the seven places there mentioned.

GRAETZ (late Lat. Gratum: Slav. Nimetzki-Grad). The capital of the duchy of Styria in the Austrian dominions. It is a walled town with six gates; and has three bridges, over the Mühr, leading to as many suburbs. The houses are generally large; the streets are well paved, but mostly dirty, steep, narrow, and dark. The chief church, built of hewn stone in a Pointed style 1450-6, is 192 Ger. ft. long, 89 ft. wide, and 81 ft. high, and serves as the cathedral of Seckau; near it is the mausoleum of Ferdinand II, 1619-37, of a Corinthian order with a cupola. The other edifices comprise the haupt-pfarrkirche 1466, with a wooden tower 1781; the church of S. Leonhard 1433; the Lechkirche 1283; the Mariahilferkirche, about 1580-1620, with an interior 1769; the S. Andreaskirche 1624; the Barmherzigerkirche 1615; the great room in the monastery of the Minorites: the Calvary, one of the most remarkable in the country: the column of the Virgin: the burg or old palace, with a tower and four courts, now the governor's residence: the land-haus; for the local assemblies 1557-67: the rath-haus, 1807 by Christian Stadler: the theatre and assembly rooms, 1825 by P. Nobile: the prison: the schiess-stätte or shooter's stand 1795: the Johanneum or museum: the arsenal: the Bemalte-haus with external fresco paintings of the seventeenth century: with the Attems, Saurau, and Trautmannsdorf palaces. There are also seventeen other churches, two monasteries, three nunneries, the university, thirty public schools, and about a dozen hospitals, none of which are of much interest. The local guides are BENDITSCH, *Topographischekunde*, 8vo., 1806; KUMAR, *Streifzüge*, 8vo., 1816; and POLSTERER, *G. und Seine Umgeben*, 8vo., 1827.

26. 28. 96.

GRAETZ (HANS VON) was engaged 16 May 1483 at an annual salary of 180 Rhenish gold florins 'per conclusionem de la fabrica del tiburio' of the cathedral at Milan, for which city he started 11 October. His work was destroyed before 1490 for that upon which G. G. DOLCEBUONO was employed: FRANCHETTI, *Storia*, 4to., Milan, 1821, p. 15-18. This Hans is supposed to have been sent from Strasburg in consequence of application for an architect made 27 January 1481, and 19 April 1482, to the magistrates of that city by G. G. Visconti, given in FIORILLO, *Geschichte*, 8vo., Hanover, 1815, i, 360-1.

GRAETZ (HANS VON), see NIESENBERGER (H. VON).

GRAFTING TOOL. A long and narrow spade, curved in the direction of its breadth like a gouge, and used by brick-makers and navigators in digging clay or other stiff soil. A. A.

GRAHAM (J. G.), see GILLESPIE-GRAHAM (J.)

GRAHL or GRAEL (JOHANN FRIEDRICH), born 1708 at Quilitz near Schwedt in Prussia, was a pupil of Boehm and Diterichs. He built at Potsdam the Heiligegeistkirche, and at Berlin the von Bork and Kamki palaces; the tower of the Sophienkirche; and the church of S. Peter. Having incurred disgrace (which seems unmerited according to the details given by NICOLAI, *Beschreibung*, 8vo., Berlin, 1786, i, 222-3) by the fall 21 Aug. 1734 of its tower built by Gerlach, he returned to Schwedt, where he built for the margrave of Bayreuth a riding-house, barracks, etc.; and died 1740.

68.

GRAIN. The direction of the fibre of wood. In NEVE it is stated that "feltgrain is that grain which is seen to run round in rings at the end of a tree; and quarter-grain that which is seen (particularly in cleaving laths) to run in straight lines towards the pith." STUART, *Dict.*, says "feltgrain is the mode of splitting or sawing timber in a line passing across the centre or heart of the tree; as opposed to the mode of cutting which, following as near as may be the course of the annular rings, is called quarter-grain"; but this appears to be an error, as a lath-render still uses feltgrain in the sense given by NEVE, although he calls the quarter grain the chink grain. *Felting* is the act of splitting timber by the feltgrain.

8

GRAINING. The art of imitating the finished surfaces of expensive woods, as wainscot, satin wood, maple, etc., by means of pigments, varnishes, etc. LERSIUS, *Denkmaler aus Aegypten*, etc., fol., Berlin, 1849-59, Abth. ii, pl. 19-21, shows imitations of wood lining found in tombs in Egypt of the fourth and fifth dynasties (the age of the pyramids); the graining is apparently intended to represent two woods, with marbled panels above them.

This art, however, as now practised to imitate wood, seems to be of modern English origin, having been unknown till very lately on the continent. This circumstance is the more curious, as the art of imitating marbles, etc., is pursued abroad, especially in Italy, with great success. **MARBLING.** As late as the year 1798, TAYLOR, *Builders' Price Book*, gives prices for "mahogany grained"; "do. and varnished"; "do. stained to book-case"; but no mention is made of grained wainscot, or any other wood. Grained wainscot was done in 1810, mahogany in 1815, and maple wood in 1817; till at last in 1818 not only are ordinary grained mahogany and wainscot mentioned, but white oak, air wood, satin wood, Honduras mahogany, Hispaniola mahogany, rose wood, and yew tree. Other woods were speedily added.

Besides the tradition that marbling and graining were introduced from France about 1782 by H. Holland at Carlton house, the origin of the art is thus traditionally stated. At the time of the breaking out of the French Revolution it was almost impossible to obtain the more valuable woods, and English oak was in such demand for ship building, and walnut for gun stocks, that scarcely anything but deal and beech was to be had. The furniture manufacturers therefore used these woods as much as they could; such articles as bed posts, office stools, etc., were made of white woods stained a sort of dull mahogany colour with orchil. The joiner next took this up, and stained common deal hand rails in the same way. The next attempt was to imitate wainscot. This was done by painting the work in oil of a brownish tone, but the colour was thicker than usual, and instead of being laid smoothly as usual, it was smeared in long streaks to represent the *grain* of the wood, and sometimes beaten when half dry with a large brush. In fact, it is supposed the term arose from this circumstance. To this succeeded the use of combs of bone with blunt points and of various degrees of coarseness. These being scratched over the wet paint left the ground visible; and the result was such a manifest improvement over the old system, that graining began to become very popular. The success led next to take out the cross white veins or 'champs' as they are technically called. This was at first done, it was said, by imitating the forms with a camel hair pencil dipped in spirit, and wiping them off with a cloth. The next improvement was taking out the 'champs' with the corners of a piece of soft leather doubled up. But the greatest improvement was the invention of 'over-veining'. This is done with a wide flat brush, the hairs of which are long and slender, dipped in transparent colour, when the hairs stick together in a sort of lock like the hairs of the head after bathing. The cross veins of the wood are dexterously imitated with this tool, and show the other veins below. Other most ingenious expedients have been devised to imitate the knots, veins, spots, 'swirls', 'mottles', etc., of various woods. Pieces of sponge, of decayed cork, of hen's feather, in fact of anything that will make marks in the wet colour like those in the natural wood, have been resorted to. The little dark spots with a lighter shade round them in maple wood, are imitated by dexterous touches with the tips of the fingers on the wet pigment.

Graining colours are of various sorts. At first the wainscot was done with common oil colour: but as this clogged the combs, at present the vehicle is generally some soap dissolved in turpentine, to which a little boiled oil is added. Almost every other wood is imitated in distemper, the favourite vehicle for which is small beer, that medium being found to be sufficiently glutinous,

without the aid of size, to prevent it rubbing off by the application of the copal varnish which follows soon afterwards. A. A.

The graining operations are generally done after the wood has been prepared by the usual number of coats of paint: one advantage of the process of graining consists in compelling the painter to lay on thick coats of paint, as otherwise he could not use the combs, etc. Hence it is that grained work is more durable than plain paint. A method of graining wood, on the wood itself, without these preliminary coats, was described by W. PAPWORTH, *Notes on House Painting*, etc., in *Transactions of the Royal Inst. Brit. Architects*, 1857-8.

"The great advantage which grained woodwork has over that which is simply painted—is that it is so easily kept clean. The surface of painted wood is always somewhat rough, and catches the dirt readily, and white lead always oxidises or changes colour, more or less. The grained surface, on the contrary, being made smooth by varnish, does not become readily soiled, and when it does, a moment's application of a damp cloth will make all clean and bright; while if the same surface were painted only, it would require frequent and most vigorous scrubbing to restore it to its original condition. Every one who has made a trial of grained, or stained and varnished woodwork, will agree that it is a great economy of time and labour in housekeeping, while the addition to the cost of plain painting is very trifling. Ash, maple, birch, and oak, are [considered in America to be] the best woods to imitate. Black walnut, if not too dark, has an excellent effect.—Grained woodwork is a great assistance in making a room look furnished, with but little furniture, a point sometimes of no trifling importance"; DOWNING, *Country Houses*, 8vo., New York, 1850, p. 367.

Messrs. Kershaw and Bellamy patented 17 November 1854 certain tools for the imitation of woods, and received medals in 1851 and 1855; — Browning invented 1857 a method of imitating the grain of woods by machinery; and John Strather of Hull produced 1858 oak or wainscot papers, printed from the grain of the wood itself; a different pattern appearing with each shaving taken off the plank.

TINGRY, *Painter's and Varnisher's Guide*, 8vo., Lond., 1804, 1816, and 1832; WHITTOCK, *Decorative Painter's, etc., Guide*, 4to., Lond., 1827, 1832, and 1841; HIGGINS, *Painter's and Decorator's Comp.*, 4to., Lond., 1841; MOXON, *Grainer's Guide*, Edinb., 1842; BARBER, *Painter's, etc., Assistant*, 12mo., Lond., 1852; *Wood and Marble Imitator's Manual*, 8vo., Edinb.; *The Painter and Decorator* (WEALE), 12mo.

GRAMONDIA (LOUIS DE, see ALBITURIZ (A.))

GRAN (late Lat. Strigonium; Hung. Esztergom). A city on the river Danube in Hungary nearly destroyed by fire 13 April 1818. The cathedral, dedicated to S. Stephen, was commenced 1821 on the design of Kühnel by Packh, in an Italian style, with a portico of thirty-eight pillars, a dome 82 Ger. ft. in diameter and 250 ft. high, and an interior enriched by walls of red marble and fifty-four columns; although consecrated 1823, it has only been recently completed; on the left side is the remnant of the former (1507) building, which forms a chapel 45 ft. long, 27 ft. wide, and 46 ft. high; and on the right side is a chapel of similar size dedicated to S. Stephen. The church is 336 ft. long, 134 ft. wide in the transepts but 114 ft. in the nave, with a front towards the Donau rendered 650 ft. long by the archiepiscopal residence and other buildings attached as wings to it, which form an imposing mass standing on a high rock overlooking the town. Two other churches, as many monasteries and two nunneries, the town-hall in the centre of the great square, the government offices, two public schools, and as many hospitals, are all worth notice. 26. 28. 50. 96.

GRANADA (It. Granata; Fr. Grenade). The capital of the province of the same name in Andalusia. The city itself, like its suburbs, Antiquera (the working population) between Albaicin on one hill and ALHAMBRA on another, consists of twenty-four plazas and narrow winding streets, with the

eleven large open spaces chiefly laid out as gardens, which form the characteristic feature of this town. Many houses are handsome, and more are interesting (but less so than those at Seville) for their Moresque features. The houses in the valley are those of the richest population, smaller, and less Oriental. Except on the north side, there are no remains of the celebrated walls and towers. The Albaicin quarter is now a heap of ruins of fine Moresque mansions; and the town is gradually going to decay; indeed the theatre built by the French for 1300 persons is found inconveniently large: when the monastic establishments were secularized, many became private houses, as the government offices were not numerous enough to occupy them. The existence of footways, and of glass lamps instead of horn lanterns in some of the streets, is still thought remarkable.

The cathedral, dedicated to Sta. Maria de la Encarnacion, was commenced 15 March 1529 by D. de Siloe, consecrated 17 August 1560, and continued on his death 1563 by J. de Maeda till 1574, and afterwards by J. de Orea. The transept and one tower (to its present height of three stories) were constructed 1576-83, but the main structure was not considered as completed until 1639: and still the west front with one base for a tower remains unfinished like the present tower, which is 200 Sp. ft. high, but wants 85 ft. more according to the existing original design. The structure is five-ailed, and also has chapels; the interior, decorated with grouped columns of a Corinthian order, is 425 ft. long, and 249 ft. across the transepts; with a cupola 220 ft. high on twelve arches, and an arch 190 ft. high to the *coro* in the nave. The capilla-mayor is considered to be one of the finest specimens of art in Spain: the capilla real, wherein Ferdinand and Isabella are entombed, is a separate establishment finished in a Gothic style 1510-25, and attributed to F. Vigarini: the chapel of S. Miguel was designed 1804 by F. Romero. Annexed to the cathedral is a Churriguesque church called el Sagrario, erected 1705-59 on the site of the great mosque: indeed the front of the archiepiscopal palace forming the north side of its *plaza* was Moresque until 1843. About half of the sixty churches which Granada once possessed have been secularized: of the remainder, allotted to the service of fourteen parishes, the chief are those of Sta. Magdalena, 1567; Sta. Escolastica, once Dominican; SS. Justo y Pastor, once Jesuit; la Concepcion, the celebrated and magnificent church of the Hieronymites; S. Ildefonso; Sta. Ana, with a fine tower; la Asuncion, once Carthusian; N. S. de las Angustias, with two towers, 1550; la Encarnacion, once Franciscan; S. Salvador, by A. de Vega; and S. Salvador, S. Nicolas, and S. Juan de los Reyes, which originally were mosques, like S. José, which is a modern church attached to an older tower.

The chief buildings are the Churriguesque *casas de cabildo*; the cancelleria of the palacio de la audiencia, built 1584-7 by M. Diaz Navarro and A. Hernandez, probably from a design by J. de Herrera, with a handsome staircase and corridors, but every other part unfinished; the casa de ayuntamiento, 1729; the university, once the Jesuit college; the seminario; the church, sacristy, and little cloister of the Carthusians, remarkable for the *sagrario* designed in his peculiar style by F. Hurtado Izquierdo, a contemporary of Churriguerra; the cavalry barrack, formerly the Hieronymite monastery, with a cloister attributed to Siloe, and curious as shewing the transition which occurred 1496-1519, its church 1519-52 was the mausoleum of Gonsalvo Ferdinand, the great captain, ob. 1515; the cavalry barrack, formerly the Carmen Calzado; the infantry barrack, formerly the Mercenarios Calzados, and its hospital, once the church; the *bagne*, formerly the Mercenarios Descalzados, and its workshop, once the church; the picture gallery and Academy of Fine Arts, in the Dominican monastery; the palace of the captain-general, and the military offices, in the Franciscan monastery which had been rebuilt since 1815; the custom house, formerly belonging to the Trinitarios Calzados; the church of the Trinitarios Descalzados, now a storehouse for

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wood; the other three monasteries; the nineteen nunneries, especially the Franciscan church of Sta. Isabel; the seven hospitals, including that of S. Juan de Dios for 500 patients (1552-1725); and the Gothic and Plateresque lunatic asylum; the alcaxeria or Moresque bazaar; and the stone amphitheatre for bull-fights, which is one of the best in Spain. Besides these may be noticed the Moresque doorway of the casa del carbon, with the arches, called puerta de Elvira, de las Granadas, judiciaria (with the arm and hand 1308) de las Orejas, de las Cucharas; and the puente Quemada, under which passes the road to the church of the Sagromonte, erected about 1575-8 by A. Vico. ALHAMBRA; GENERALIFE. 28. 85. 96.

GRANADILLO. The name given in Cuba and the West Indies to the BRYA or AMERIMNUM Ebenus, called Jamaica, and Green, EBONY. 71.

GRANADOS (JOSEF), maestro mayor to the cathedral at Granada, was invited 16 October 1682 to survey the works that had fallen at the collegiate church of S. Salvador at Seville. He died before 1694, in which year a committee of architects reported that F. Gomez Septier had satisfactorily continued the works that Granados had designed during his visit of six weeks duration in 1682, and which were not finished until 1712. 66.

GRANARY (It. *granajo*, *granaro*; Sp. *granero*; Fr. *grenier*; Ger. *getreideboden*). The place in which grain, especially corn, is to be kept. The great requisites for a good granary are that it should be dry, well ventilated, and free from access of vermin. It should also be cool; for though the ordinary English temperatures do not affect corn if kept dry, any heat coming on damp is very injurious. In small farms the granary is generally a timber framed, weather boarded building, raised about three or four feet from the ground, and supported by cylindrical piers, on the tops of which are broad caps, projecting over far enough to prevent vermin creeping up and getting in under the floors; the air passing through the cracks of the weather boards is sufficient for ventilation. In larger modern farms the granary is usually over the place where the threshing machine is kept; and there is generally some contrivance attached to the machine for hoisting the grain; and traps in the floors for filling the sacks. The rooms below granaries should never be used for stowing hay or straw, as they are apt to harbour vermin.

In building large granaries for corn merchants or public purposes, it must be remembered that all grain requires frequent turning, and that it is seldom laid on the floors when loose or "in bulk" at greater depths than 2 ft. 6 ins. to 3 ft.; so that the stories need not, for sake of economy, be higher than about 8 ft. The floor boards should be at least 1½ in. sound yellow deal, as there is considerable wear from the shovels; and ploughed and tongued, as it is desirable to avoid plastering. There should also be no wall linings, as they harbour vermin. It is best to keep corn in bins with passages between them, so that cats can easily pass. If in bulk, it is best kept a short distance from the outer walls by upright boards, for the same reason. Granaries are generally ventilated by windows hung to swing, placed as high as possible, and opposite to each other to ensure thorough draughts. Some prefer wooden luffer boards. Large establishments often have apparatus for cleaning grain; but as this necessitates the motive power of steam or water, a portion then generally becomes a mill, with grinding, bolting, dressing, and smut machines, joggling screens, sack tackle, and with stowage for flour, sharps, bran, pollard, etc. If there be no regular sack tackle, proper cranes, windlasses, or other hoisting tackle should be employed, with sack traps, hoppers for passing the corn from floor to floor, etc. A. A.

But DEAN, *Farm Buildings*, 4to., London, 1849, says that "the granary should be raised about seven feet from the ground, the lower part being used as straw shed or general provision store: it should adjoin the machine-house;—the walls for 6 ft. high are to be lined with boards all round the interior to keep off damp," etc.

In designing a large granary something more than the means of storing a quantity of grain in the least possible space has to be considered. The future flour will reveal not only the diseases and the insects which may have been stored with the corn, but even some of the means that were used to clean the grain; it may be necessary, therefore, to prepare for cleaning the corn before it is stored. The owner of the grain may be satisfied with having the walls, etc., of the granary covered with naphthaline: or with turning the corn from once to thrice a week, as at Amsterdam and Danzig respectively, where the grain is kept from 33 ins. to 39 ins. deep in stories from 10 ft. to 9 ft. high; or as in London, where the depth of the grain varies from 26 ins. to 36 ins.: or he may include provision for cleaning the grain, and for afterwards drying the corn before it is stored. These processes and the space required for them are described by ROLLER, *Mémoire sur la Meunerie*, 4to., Paris, 1847, p. 64-106, and atlas plates. The machinery for cleaning grain invented by Vallery is described in the *CIVIL ENGINEER Journal*, 1845, viii, 85, and is praised by ROLLER, who objects to it and all other processes in which air gets to the stored grain, that corn loses its germinative qualities if kept longer than two years in a place to which air has access. The great defect of granaries built as in England of many floors by the side of a river or the sea, is that their situation assists the putrefaction of the grain by heat and moisture, whence the corn necessarily has to be turned to ventilate it and clear out the vermin. It may be further added that brick floors are said to cause the grain to be infested, and that the resinous odour from fir or larch seems to keep insects at a distance; indeed it has been recommended to place turpentine or the resinous boughs of the Thuja and Virginia cedar in damaged wheat, in order to drive out the weevil. ROLLER notices the use in London of partitions made of brass wirework with small meshes to keep away mice.

There are three systems of storage, viz.: with natural ventilation; with artificial ventilation; and with the exclusion of air. The first is represented by the *granary* above ground as usually seen: the third by the *silo* underground: and the second seems to be a combination of the two, consisting of a close granary or *silo* above ground, into which sometimes air is forced; and the consideration of them will follow in this order.

The granary above ground consists of a wood, brick, or stone building with loopholes; of a building with loopholes, supported on pillars or piers; or else of an open building with columns carrying bins so that air may pass below the floor and between the bins: this has been as much adopted by the Chinese as by the Romans, and by the English and Swiss of the present day; but the Chinese dry their corn either by the heat of the sun or of a stove before it is stored; and do not recognize the necessity for subsequently turning it. YARRANTON, *England's Improvement*, 8vo., Lond., 1677, p. 135-7, urged the erection of well built brick granaries 300 ft. long, 18 ft. wide inside, of seven floors each 7 ft. high, to hold 2,000 quarters in each loft after the pattern of one built at Shenibank in the vale of Parimburch on the Elbe, which was then the storehouse for wheat to be sent to Brunswick.

The *silo* (It. *buca*; Sp. *silo*, *sitia*, *matamoro*), as it is generally called, consists of a close pit. This system seems to have been adopted by the ancient nations (except the Egyptians, in consequence of the rise of the Nile), and in modern times by the inhabitants of Asia, of the eastern half of Europe, and of the shores of the Mediterranean; indeed so late as 1515-47 it was in use at the town of Ardres in France. At Girgenti the royal magazines are formed in caverns or cisterns cut out of the rock, in which grain is kept so dry that it swells a twentieth part when removed into the air; DE NON, *Travels in Sicily*, 8vo., London, 1789, p. 235: but in the Italian silos an increase of one-fiftieth only by measure is admitted by ROLLER.

The Chinese are content with a quarry which they line with straw if damp is to be feared: or with a pit or trench of earth which is first filled with brushwood that is set on fire to convert

the natural material into a sort of terra-cotta; the bottom and sides are lined with mats or straw, and the air at top is carefully excluded by mats and straw under a mound of earth. The contents are exposed for two or three days to the sun before storage, for undried grain is never put by the Chinese, the Arabs, or the Moors into such pits, which in Algiers and Tunis are square with a depth of 30 to 45 ft. Two or three hundred pits are sometimes dug in the same place, each pit containing at least four hundred bushels of corn; SHAW, *Travels*, 4to., London, 1757, p. 139; LORR, *Algiers*, 8vo., London, 1835, i, 150, 167. In Naples and Tuscany, as well as in the south and west of Spain, as at Barcelona, as described by DE LASTEYRIE, *Des fosses propres à la conservation des graines*, 4to., Paris, 1819, the system is to excavate in the rock a chamber about 32 ft. deep and 13 ft. in diameter, with a domed top and manhole, lined with 3 ins. of straw or of brickwork, into which the corn is poured on a floor of faggots covered with mats, is trodden down at each 10 ft., and is covered with straw and temporary defence for a fortnight to allow the grain to sink together; the *silo* is then filled up, covered with straw, the manhole is closed by a stone plastered at the joints, and the whole is covered with about 3 ft. of earth. A cylinder with a conical bottom and a domed roof sunk in the earth was proposed in the *CIVIL ENGINEER Journal*, 1848, xi, 42, with the addition of an air-pump for exhausting the air, an archimedian screw for discharging the grain, and (most curiously) a pump for clearing away water should the grain be wet. In Hindostan, as at Mysore, paddy, that is rice in the husk, is stored in large earthen jars; in pits called *hagays*, 15 or 16 cubits deep, the sides being then cut away to form a cave, with about two cubits of earth as roof, lined with straw all round and filled with paddy, each pit holding from 83 to 167 Winchester bushels: the whole pit must be emptied when opened. *Canajas* are built storehouses, with plank floors, without openings for air but a row of doors, one above another, for taking out the grain. *Wodays* or small cylindrical clay pots are also used, with a tight fitting cap, the paddy being removed at a small hole at the bottom as required. Paddy is said to keep two years without alteration, and four years without being unfit for use. Grain in the husk is also kept in large bamboo baskets from 6 to 9 ft. high, and from 3 to 5 ft. in diameter, called *vallavuttis*, coated on the outside with a mixture of cowdung and clay and covered with air-tight lids, and placed on planks raised above the floor on stones. Rough rice is kept in larger baskets called *vullams*, containing from 65 to 130 bushels each, placed under sheds built for the purpose; in either of these, rough rice will keep for three years; BUCHANAN, *Mysore*, etc., 4to., London, 1807, i, 90, ii, 374.

The system of *silos* above ground is not so new as it was imagined to be by ROLLER; for at Bankipore is a building called the *golah*, of a beehive shape, 96 ft. high and 126 paces round, with two flights of steps to the summit, where is an opening for filling it with corn, with four doors at the bottom for access; it has never been used; FORRESTER, *Ganges*, etc., 4to., London, 1822, p. 147: and at Patna, was built after the famine of 1770 the first of a series of similar stone structures 200 ft. high, intended to have been placed in all the principal towns in Behar; it is shewn in the *ILLUSTRATED LONDON NEWS Journal*, 1850, xvi, 416. Sir John Sinclair proposed a tower of brick, with air holes about 5 ins. square on each side at alternate heights; the bottom formed of hoppers opening into one general one from whence the grain was allowed to fall into sacks when wanted, the tower being filled from the top; several were built in England with great success; LA PROPRIÉTÉ *Journal*, 4to., Paris, 1833, etc., 52, pl. 3. M. Fluen proposed a building for the preservation of grain in large masses, placed in divisions of compartments or *silos* occupying the whole height of the building; *BUILDER Journal*, 1856, xiv, 137. In the early part of 1861 grain was tested which had been buried for two years in pits dug in the earth and lined with masonry or brickwork, and afterwards

GRANARY.

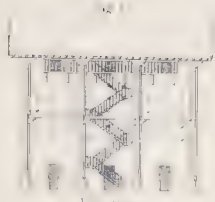


Fig. 1

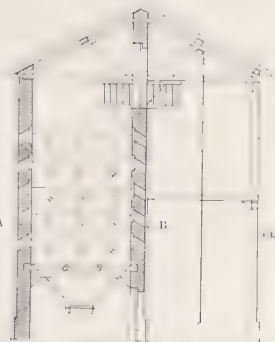


Fig. 3

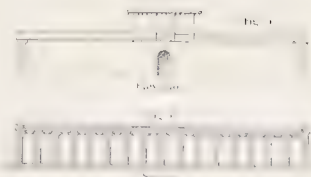


Fig. 4

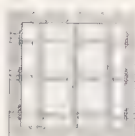


Fig. 5

Fig. 5

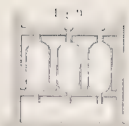


Fig. 6

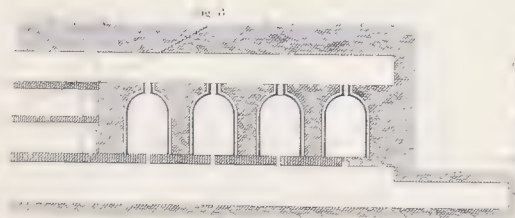


Fig. 7

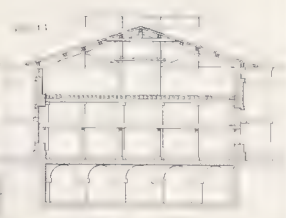


Fig. 8

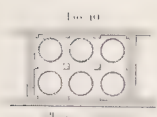


Fig. 9

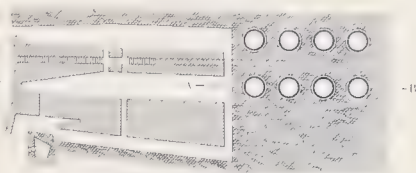


Fig. 10

Fig. 10



Fig. 11

Fig. 11

Fig. 12

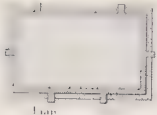


Fig. 12

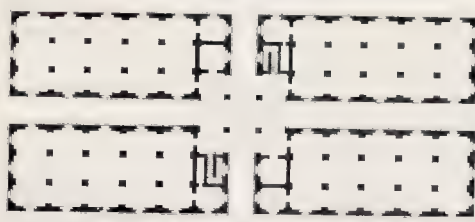


Fig. 13

Fig. 13

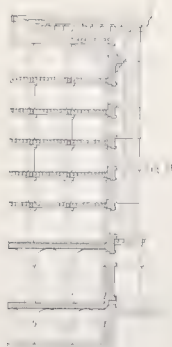


Fig. 14

Fig. 14

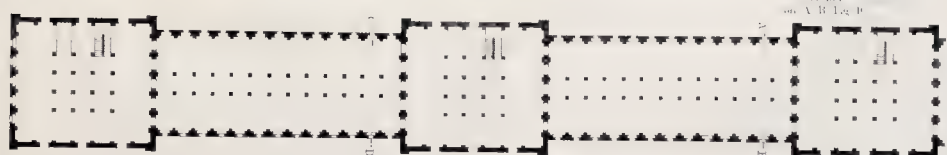
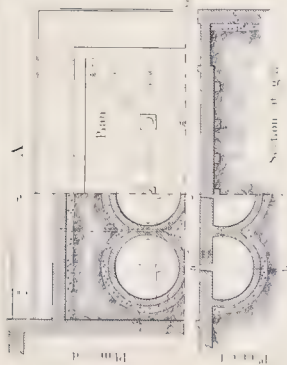
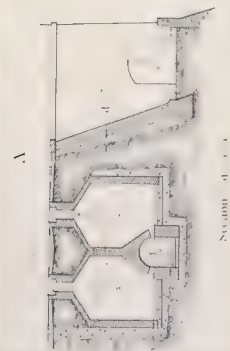


Fig. 15

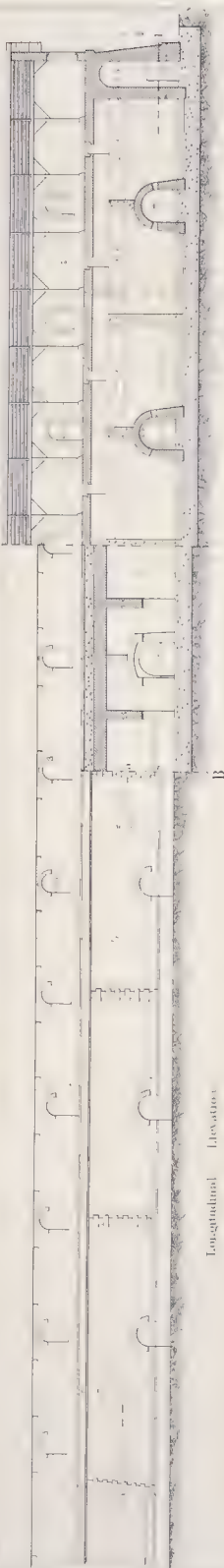
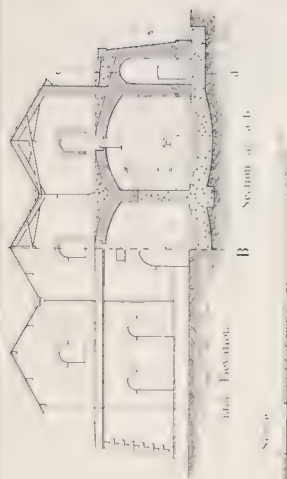
Fig. 15





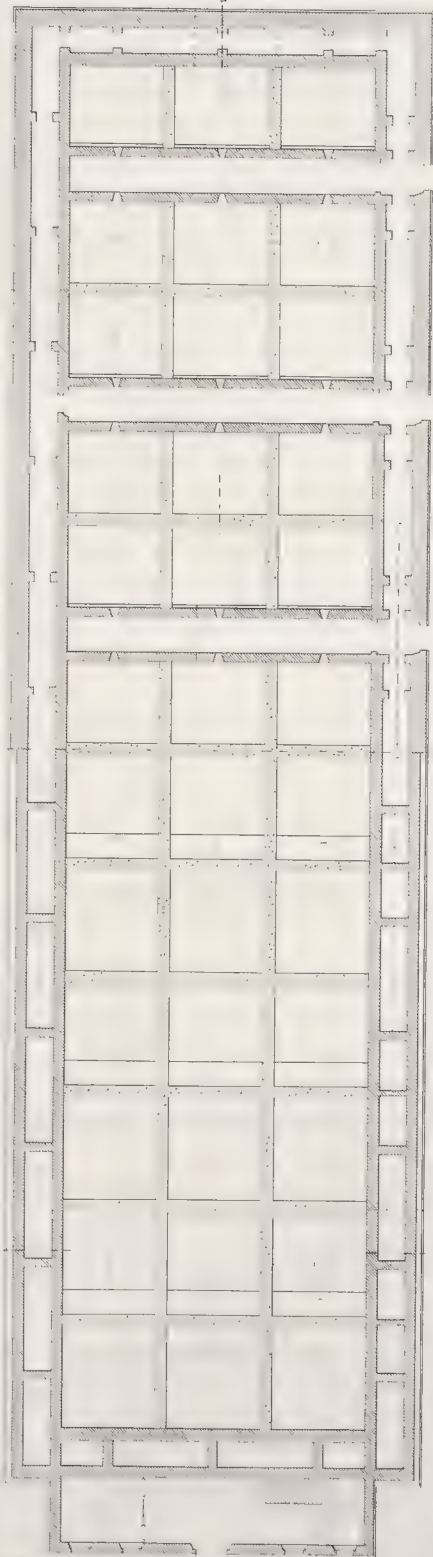
CRANARY (SILO)

AA Silos at
BB Silos at



Section at a-a

Section at b-b



Plan g-h



with thin sheet iron, the grain appearing in good condition; *BUILDER Journal*, 1861, xix, 639. Mr. Alex. Devaux has patented a granary consisting of upright silos constructed of perforated iron and erected above ground, cool air being driven into the several divisions through a central perforated iron tube to keep the grain dry: besides the model granary erected about 1860 in the West India docks, London, one of large extent has since been erected at Trieste, and it is now contemplated to build a similar one in London, for which and other purposes a limited liability company was forming in 1863.

ROLLET thought that he should combine the success of the Spanish and Italian pits, and of the method adopted by the Knights of Malta, viz. the storage of well dried corn in metal casks in cellars, by putting an iron silo into a pit; he enforces his argument in favour of this plan by observing that the cost of one to hold 3,300 bushels would be £150, and that the reserve of corn kept 18 ins. deep in an arsenal for 200,000 would occupy the space allowed for lodging 20,000 men. The ultimate decision in regard to commercial granaries seems to be tending towards the provision of places, for cleansing (by some method) the grain and for loading it, over waterproof and airtight silos. *.*

The system of silos introduced by M. Doyère is founded upon an imitation of the ancient method of storing grain in excavations or pits sunk in the ground. M. Doyère was led to this system by the fact that all those in actual operation proceeded upon the principle of an active ventilation; and the inference he drew from this fact was, that the grain treated in that manner was exposed to a species of slow combustion in the substance of the grain. "Thus the airing of the grain, which is necessary to preserve it from fermentation and heating, takes from it a part of its own substance; and the more energetic this airing is, the more considerable is the loss due to this cause, other things being equal", as M. Hervé Mangon, the reporter of the jury of class ix in the Exhibition of 1862, said. "It can thus be understood how it is possible by mechanical means, more or less ingenious, to reduce the expense of shovelling and winnowing by hand, and consequently render a great service to the corn trade. But it must be remembered that this process, however ingenious it may be, cannot get rid of the causes of waste inherent to the nature of the grain." "After long and laborious studies, M. Doyère perceived that corn enclosed in vessels impermeable to the air, with certain precautions easily taken, and which he has accurately laid down, can be preserved without being disturbed, without change, and without loss."

The vessels employed by M. Doyère, as will be seen by the *Illustrations*, consist of thin sheet iron, coated with a particular kind of varnish and enclosed in concrete or masonry. The pits themselves may be either sunk in the ground or erected in open air—the granary of Casabianda in Corsica is an illustration of the first, that of Toulon of the second; the only indispensable condition is that the access of the atmosphere should be effectually arrested. The corn is introduced at the top; it is withdrawn at the bottom; and so successful has this system been, that the French government have applied it for the ports of Cherbourg, Toulon, Brest, Corsica, Algiers, etc.; and are about to erect large magazines of this description in Paris. Grain thus stored has been found to weigh, pound per pound, precisely the same after eighteen months experience. DOYÈRE, *Mémoire sur l'ensilage rationnel*, 8vo., Paris, 1856; and *Conservation des graines par l'ensilage*, 8vo., Paris, 1862. G. R. N.

The *Poires d'Ardres*, which are nine magazines each of six chambers 8 ft. diameter and 12 ft. high, on a vaulted cellar 30 ft. long by 20 ft. wide and 10 ft. high (probably erected 1515-47) are shewn in BELIDOR, *Architecture Hydraulique*, 4to., Paris, 1780; the *ALLGEMEINE BAUZEITUNG*, 1852, pl. 489-91, illustrates Sinclair's granary, and others at the following places; Corbeil, of eight floors 262 ft. 6 ins. long and 49 ft. wide inside, said to be sufficient to supply Paris for a fortnight;

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Lille, of eight floors over one arched story 210 ft. long and 60 ft. 8 ins. wide; Naples, of four floors all arched, 1181 ft. long and 55 ft. 9 ins. wide; Berne, 279 ft. long and 65 ft. 6 ins. wide; Paris, of six floors and two arched, 1148 ft. 4 ins. long and 62 ft. 4 ins. wide; Lyon, 416 ft. 7 ins. long and 52 ft. 6 ins. wide; Genoa (by Aicardo), in a series of four buildings each 118 ft. long and 49 ft. wide (also given in GAUTHIER, *Genoa*, i, 45); and the silos in pl. 492, at Amboise, Leghorn, Naples, Ardres, and Paris, together with Vallery's circular revolving granary; one of which capable of cleaning 1000 bushels at a time is used in the following building. The emperor of Russia about 1833 ordered the erection of several granaries on the Vistula, of which one was built at Nowogrogeorgiewsk, formerly called Modlin, near Warsaw, 1835-40 by Jacob Gay; it is 570 ft. long, and of five floors over a casemated floor, as the building is likewise prepared for military purposes: *ALLGEMEINE BAUZEITUNG*, 1844, series i, pl. 579, etc.; *ARCHITECT Journal*, 1850, ii, 361-7; and *CIVIL ENGINEER Journal*, 1850, xiii, 241. BRUYÈRE, *Etudes relatives à l'art des constructions* (Greniers publics et halles aux grains), fol., Paris, 1823-8; VOIT, *Über die Aufbewahrung des Getreides in Scheunen*, etc., 8vo., 1847; VAUDoyer, *Projets d'Arch.—Grands prix*, etc., in 1797, fol., Paris, 1806. WEIGHT, *FARM BUILDINGS. Illustrations*, s. v. Granary.

GRAND (JEAN LE) executed 1660 the observatory at Paris from the plan of Claude Perrault. 68.

GRAND (. . . LE), was elected 1728 a member of the Academy of Architecture at Paris, and died 1751. He was succeeded by Cartaud as architect to the duke of Orleans at the palais royal: BLONDEL, *Arch. Franç.*, fol., Paris, 1752, iii, 40; *L'Homme du Monde*, 8vo., Amsterdam, 1774, ii, 295.

GRAND (JACQUES GUILLAUME LE), born 9 May 1743 at Paris, was a pupil of his father-in-law Clerisseau, and entered into partnership with Molinos. Separately he restored the fontaine des Innocens, 1788, and designed the arrangement of the place to which it was removed; and the repetition of the lantern of Demosthenes in the park at S. Cloud. KRAFFT, *Plans, etc., des plus belles maisons*, fol., Paris, 1801, gives, pl. 110, the roof by them of the halle au blé, 1783 (destroyed 1802); pl. 31, the house by him in the rue de Monsieur for M. Jarnac, 1788; pl. 108, the greenhouse by them in the jardin botanique, 1796; and pl. 81, the decorations of the salon (1790), with pl. 95, those of the library of the hôtel Marbeuf, by them; they also designed 1789-90 the (French-Greek) théâtre Feydeau, which was destroyed for the bourse; and 1786 the halle au drap: DUBUT, *Maisons de ville et de Campagne*, fol., Paris, 1803, gives the library, the morgue, and the halle au drap. He wrote a *Parallèle de l'architecture ancienne et moderne*, 4to., Paris, 1799; edited with VISCONTI, *Œuvres de J. B. et F. Piranesi sur l'architecture et les antiquités Grecs et Romains*, fol., Paris, 1800-2; had some share in CASSAS, *Voy. pitt. en Syrie et en Egypte*, fol., Paris, 1799; but none (although attributed to him) in CASSAS, *Voy. pitt. d'Istrie*, fol., Paris, 1802, which was by J. LAVALLEE; and besides writing the text to CLERISSEAU, *Antiquités*, fol., Paris, 1804; wrote (with MOLINOS) five *Mémoires sur les sépultures*, 8vo.; *Galerie antique*, with engravings by BOUTROIS, fol., Paris, 1806; with LANDON, one part of *Description de Paris*, 8vo., Paris, 1807; and a translation of COLONNA, *Hypnerotomachia*, 12mo., Paris, 1804. KRAFFT, *Les plus beaux jardins*, fol., Paris, 1810, ii, 3, gives the garden by Le Grand with Molinos in the rue des Aman diers; and, 67-8, Le Grand's garden placed upon the roof 80 ft. long and 30 ft. wide of the house of M. d'Etienne, in the rue Caumartin, both at Paris. After the death at S. Denis, 9 Nov. 1807, of Le Grand, his *Essai sur l'histoire générale de l'architecture* was published as the text to DURAND's *Recueil*, fol., Paris, 1809, by Molinos, who added a memoir of his friend to the edition, 8vo., 1810. Another memoir by Landon is in the supplementary volume of the *Annales du Musée*. 110, 112.

GRAND (. . . LE) was 1804 a member of the Academy

of Fine Arts at S. Petersburg, according to FUESSL, *Lexicon*, Supp.

GRANDE (ANTONIO DEL) was paid 1653 for estimating the value of the houses on the site of the Carceri nuove at Rome, of which he may have been the architect, as they were erected 1647-55. He also built the palazzo di Spagna at Rome, as appears from his memorial dated 17 June 1655, requesting that in consideration of the advanced age and services as royal architect of this Antonio, some bishopric in Italy should be given to his son. The gallery of the palazzo Colonna is ascribed by some writers to him, by others to Girolamo Fontana and to P. Schorr. MORONI, *Dizionario*, 8vo., Venice, 1841, s. v. Carcere, p. 267. 66.

GRANDJEAN DE MONTIGNY (A. . . .), sometimes written Grangean. He was a pupil of Percier, obtained the *grand prix* in 1799, and was at Rome when Famin arrived. A medal worth 300 fr. (second prize) was awarded 1801 to the two friends for their design for a monument to General Desaix (DETOURNELLE, *Arch. Mon.*, 4to., Paris, 1805); they exhibited 1806 conjointly; Grandjean directed for Famin the execution of pl. 74-109 of the *Architettura Toscana*, fol., Paris, 1806-15 (new edition 1846), which was followed by *Recueil des plus beaux tombeaux exécutés en Italie depuis les XV et XVI siècles*, fol., Paris, 1813. He became architect to king Jerome, for whom he built the palais du corps législatif and other edifices at Cassel. In 1816 he went to Brazil as part of the corps of French artists who were to establish the newly-founded Academy of the Fine Arts: and before 1822 had built the palais for that institution; the exchange, afterwards the custom-house; and many villas. He died between 1831 and 1850. DUSSEUX, *Les Artistes Française*, 8vo., Paris, 1851, cxii, 32, 103-6.

GRAND PRIX. The highest prize given by the French government to the student in architecture, as it carries with it a free residence during five years in the villa Medici at Rome, whence it is also called the *prix de Rome*. This prize was founded 1666, and has continued with modifications to the present time. Successful designs have been published by VANCELEMPUTTE and PRIEUR, 1779-1786, in 120 pl.; by VAUDoyer, DETOURNELLE, and ALLAIS, 1791-1805, in 120 pl.

GRAND STAND. A building, erected near the winning post, from which the privileged public can witness the running of the horses along a race course. TATTERSALL, *Sporting Architecture*, 4to., London, 1841, 91, gives views of the following; Ascot, by — Higgins, 1838-9 at a cost of £11,500; it is 97 ft. long, 52 ft. wide, and 55 ft. high, for 3,000 persons; Liverpool, by J. Foster, cost nearly £10,000, for 2,500 persons; Goodwood; Epsom, by E. W. Trendall 1829-30, cost about £16,000, standing on one acre of ground, for 5,000 persons; Chester; and Doncaster, cost about £20,000. He considers Goodwood by far the best adapted for its purposes; Epsom, too costly; Doncaster, too heavy in appearance and not sufficiently raised; and Ascot, though last built, by many degrees the worst. He objects to all of them for having a straight façade, and gives a design for one with a slightly curved front. His plans show, in the basement, a roomy kitchen and cellarage: on the ground floor, a hall 28 ft. long and 24 ft. wide; a betting room, and a steward's room, each 33 ft. long and 20 ft. wide, opening on a terrace in front; a corridor; two staircases to the roof, and others to the first floor; a public refreshment room 45 ft. long and 21 ft. wide; a private room 16 ft. long and 13 ft. wide; a ladies' cloak room of the same size; all being 12 ft. 6 ins. in height: on the first floor, a room together with its balcony holding 1000 persons, and 18 ft. 6 ins. high; a refreshment room for the visitors 70 ft. long, 21 ft. wide, and 14 ft. high; two private rooms, one 15 ft. long and 9 ft. wide; the other 19 ft. long and 9 ft. wide. The roof affords the usual standing room for spectators. The whole design is calculated to accommodate 2,000 persons, and to cost about £6,000.

The grand stand at Bath, 1830-1, is said to be well adapted for its purpose. The basement is surrounded by a colonnade over which is a verandah with steps, a saloon 50 ft. long, 22 ft. wide, and of a good height, with retiring rooms, etc. Above is the betting room, and inclined seats for 500. In front of the building is a large enclosed area for promenade. Adjoining is another stand for 500 spectators; and in the rear is stabling, 80 ft. long and 28 ft. wide, for 100 horses. Various woodcuts in the ILLUSTRATED LONDON NEWS give a general idea of the ugly effect of these buildings: Epsom, ii, 1843, 388, plan of course; iv, 1844, 329; viii, 1846, 352-3; Ascot, ii, 419, plan of course; iv, 368; viii, 385; Newcastle, iii, 1843, 13; Wolverhampton, v, 1844, 108; Doncaster, v, 189; Shrewsbury, vi, 1845, 325; Chester, viii, 308; and Manchester, x, 1847, 337. BETTING RING.

GRANGE (in late Latin *grangia*). The mediæval term (used 1303) for the place in which corn in the sheaf was preserved; perhaps the stack yard; SURTESS SOCIETY, *Finchale Priory*, 8vo., Newcastle, 1837, p. 431: but it would seem subsequently to have meant (like the present Fr. *grange*) a barn or farmer's granary, according to the following passage from SURTESS, *Durham*, fol., London, 1823, iii, 312, "there is a manor place built and consisting of a grange and an oxhouse with one chamber and a sellar for the bailiff next the gate." Upon the common system of a part giving its name to the whole, the word grange would seem to have been applied to the farm yard and buildings; and if not to every such place at a distance from its superior castle or manor house, at least to all connected with the monastic establishments. Indeed VIOLLER LE DUC, *Dict.*, s. v. *Architecture monastique*, who mentions such a farm under the names of *grange* and *métairie*, suggests that there was a grange built against the outside of the enclosure of each monastery: he notices the difference in name between the Benedictine *obedientia* and the Cistercian *villa*, and gives, p. 275, a plan of one belonging to Clairvaux. It should be noticed that this author by no means looks upon the grange as a summer residence for the abbot; in which he differs from TURNER, *Dom. Arch.*, 8vo., Lond., 1851-3, i, xxiv, ii, 258, who says that before the end of the thirteenth century it had been usual for the more wealthy monasteries to erect granges in their principal manors, sufficiently capacious to garner the produce of the harvest, and to accommodate the abbot and his attendants during an occasional retirement or when resting on a journey; (it may be suspected that many of these residences as they are called, of the abbot, were really the places of retreat or of exile for his monks, and that his visits were not always for relaxation); they also notice, iii, 167, that the granges belonging to the different abbeys were something more than farm houses, belonging rather to the class of manor houses, and have been preserved more often than most others, on account of the tenure of Church property by leasehold only.

At Minster in the Isle of Thanet, is a house built late in the twelfth century, which appears to have been a grange of S. Augustine's monastery at Canterbury according to TURNER, who gives a view of it, i, 37; and who 154, shows complete plans, etc., of the monks' house at Charney Bassett, Berkshire, a grange belonging to the abbey of Abingdon and the occasional residence of the abbot; it consists of a hall with two transverse wings, having a chapel on the upper floor of the south wing: this belongs to the thirteenth century, a period at which the farm houses were protected from roving thieves by hedges and dykes or moats. "The principal grange belonging to Beaulieu abbey, Hampshire, was at S. Leonard's, about two miles and a half to the south; and not quite a mile south-west of this was another grange, Park farm. These granges had chapels attached to them, in which certain parts of the service were occasionally performed. There are some remains of these chapels which show that they were neatly constructed. The barn at St. Leonard's shows upon how magnificent a scale their monks carried on their farming operations. It has been more

than 225 ft. long, 77 ft. wide, and upwards of 60 ft. high"; Muniz, *Hampshire*, 8vo., Winchester, 1838, ii, 298. The dairy at the Grange in Tetbury parish, Gloucestershire, is formed of part of the chapel, which is of the Decorated period. BARN.

GRANITE. A rock which is composed of quartz, felspar, and mica, in a granular form (whence its name), accompanied by some minerals, such as schorl, or tourmaline, zircon, actinolite, fluor spar, talc, etc., in variable proportions. It was formerly held that all the primary series, or the crystalline rocks, were the result of the cooling of the incandescent crust of the globe; and granite, being the lowest in order, was thought to be the oldest; so that the earlier geologists regarded this formation as the original from which, by decomposition, all others arose. But recent investigations have proved that, in the Alps, granitic masses are posterior to the lias formation, and that other formations even more recent have been altered by contact with them; so that the opinions of geologists in the present day have tended to regard granite as being possibly of very late formation, only requiring the coexistence of intense heat and gradual cooling under the influence of immense pressure.

Without entering upon the discussion of the position occupied by granite in the series of formations, it may suffice to mention that granite assumes occasionally different forms, according to the proportions of its ingredients, and to their presence or absence in the composition of the rock. Thus, pure granite consists of a mixture of about three parts of felspar, two parts of quartz, and one part of mica, whether the colour of the granite be grey, as in the case of Aberdeen, or Cornish, granites; or red, as in the case of Peterhead granite; or black, as in the case of Chinese granite. The French authors call the pure rock of this description *eurite*, which is a fine granular mass of the respective ingredients with crystals of quartz and mica well-defined; but they apply the word *pegmatite* to a variety composed of a granular mixture of quartz and felspar, with an almost total absence of mica. When felspar occurs in abnormal quantities, the granite becomes *porphyritic*, as in Devonshire granite, and the granite of S. Honorine (Calvados); the name *porphyritic* is, however, derived from the colour—purple, which was the characteristic of the Egyptian porphyries, tintured by the presence of hydrous oxide of iron; at present, the term porphyritic granite has no distinct meaning, in its secondary sense at least, and only implies the existence of large crystals of felspar in the body of the rock. When schorl takes the place of mica the rock is called a *schorly granite*, as in some parts of Devonshire; or it even passes into what is called *schorl rock* when quartz is wanting, as is often the case in the *eleans*, or courses laden with mineral matters which intersect that district. Again, when hornblende occurs instead of mica, the granite becomes *syenite*, as at Syene in Egypt, and at Malvern in England; and when hornblende is present in equal proportions with the mica, the resulting material is called *syenitic granite*. When talc is present in large proportions the granite is said to be *talcose*, or to assume a *protogenic* character; and when mica is present in such proportions as to allow the rock to assume a slaty cleavage, it is called *gneiss*, which is by some geologists considered to be a metamorphic rock, and not a crystalline deposit. Greenstone, diallage rock, and serpentine are also rocks which have become crystalline, or subcrystalline, by the proximity of the igneous rocks; trap rocks in some places pass insensibly into granitic masses; and the other volcanic series evidently bear traces of the passage from the one set of formations to the other.

Of the formations thus referred to, it is to be observed that Aberdeen granites are usually those which are, from their composition, the most durable; whilst the porphyritic varieties from Devonshire are very liable to decay from the changes produced in the felspar by atmospheric action. The existence of large deposits of Kaolin clay in the granitic districts of Devonshire and Cornwall is a proof of the danger of this de-

composition, for the materials of this clay are but derived from this source; and they are equally noticeable in the district of Limoges, and the north-western part of Spain, where granite often assumes the same appearance that it does in the west of England. The colour of both Aberdeen and Devonshire granite is a greyish neutral tint, which is at times variegated by the tints of white, yellow, and red, which are assumed by the felspar. The colour of Egyptian porphyry was red, that of the English, French, and Spanish varieties of this rock are grey; and the colour of Peterhead granite, on the contrary, is red, as is also the granite found near Nantes, in Brittany. The syenite of Egypt is of a dark grey tint; that of Malvern is of a smoky red, owing to the presence of hydrous oxide of iron in the mass; schorly granite is darker than the ordinary ternary compounds; and gneiss is generally grey, with shining scales of mica. Generally speaking granite has no planes of stratification, and it works, or cleaves, equally well in every direction; but in the porphyritic varieties there is a rough kind of arrangement of the crystals, and in gneiss there is a species of layer, formed by the plates of mica, which is plainly discernible. At all times the granitoid rocks are equally hard and resist the tool, which is obliged to work by stunning the surface: the best varieties of granite bear an excellent polish, as in the case of Aberdeen, Peterhead, and Cheesewring granites. Many of the porphyries of Egypt and of Cornwall are singularly beautiful when thus polished, although they are frequently liable to decay from the very cause which adds to their beauty, viz., the presence of the large crystals of felspar. Granite is quoted as ranging in its specific gravity from 2.625 to 2.662; it weighs on the average 166 lbs. per foot cube, and there are 13.5 ft. cube to the ton, in BEARDMORE, *Manual of Hydrology*, 8vo., Lond., 1862, who quotes the crushing force at 8,000 lbs. per inch superficial, though the experiments of George RENNIE made granite to crush under a load equal to about 10,900 lbs. per inch. LYELL, *Elementary Geology*, 8vo., 1857; DE LA BÈCHE, *Geological Observer*, 8vo., 1853; and *Geology of Devon, Somerset, and Cornwall*, 8vo., 1839; DEXMIER, Viscomte, D'Archiac, *Histoire des progrès de la Géologie* de 1834, in progress, 8vo., Paris, 1847, etc. GEOLOGY; FELSPAR. G. R. B.

In Devon and Cornwall granite occurs in five principal masses connected by smaller patches. The great masses worked for building purposes are—

1. Dartmoor, generally coarse grained, and varying considerably in colour. The grey is that generally quarried, and is worked at Hey Tor on the east, shipped at Teignmouth: at King Tor and Rignoor Down, on the west side, shipped from Plymouth. The Hey Tor granite is noticed subsequently. FOGGINTOR QUARRIES.

2. The Brown Willy district, comprised between Camelford and Liskeard, is worked at the Cheesewring quarries, six miles north of Liskeard; a very excellent granite is obtained of light grey colour, which supplied the piers for new Westminster bridge, and other large public works; and greatly resembles the Carnsew of Penryn.

3. The Hensbarrow district, near S. Austell. The eastern portion, of good quality, is worked above Par; it is shipped from that port, and known as Lostwithiel granite. The western portion, remarkable for its liability to decomposition, is worked for china clay.

4. The Carn Menezes district, supplying the granite generally known as Cornish; the quality varies greatly, is shipped from Penryn and Port Navis, and is from the parishes of Mabe Constantine and Stithians. In these districts are many large quarries in which blocks of several hundred tons are frequently raised, varying from 20 to 70 ft. long, and of large dimensions in breadth and thickness. The finest grain granite in this locality is found in the Carnsew quarries, from which the lodges and piers at the entrance to the British Museum; the plinth to the Royal Exchange; the large obelisk

fine warm coloured "Stirling-hill" stones; and second of an annular space surrounding this central nucleus of red granite, and varying much in breadth, in which the granites are found of various shades of grey and blue. The red granites differ amongst themselves in quality and composition. The prevailing compound is felspar, usually of a fine roseate hue, and at other times tending towards a pearly white. Quartz is sometimes an abundant constituent, and in other specimens it is scarcely found. Hornblende and mica both occur, but rarely in one rock, the former being the more usual. These varieties are often met with in the immediate vicinity of one another, and a granite of one kind may sometimes be found traversed by veins of a different one. As a general rule, a stone could not be matched except from the quarry whence it was cut. The textures of the various rocks likewise differ much. The felspathic crystals are found in every variety of size, from those of the coarse grained Stirling-hill stone, to rocks in which they are microscopic in size. The general impression left upon the mind by an examination of these rocks is that their character is one not of uniformity, but of great diversity. It is probable that some of these varieties might be found of commercial importance. However much the red granites differ amongst themselves, they possess one property in common, for they have a very distinct plane of cleavage. The texture of the stone itself presents to the eye no difference in appearance, but the plane of easiest cleavage is at once recognizable under the hammer of the workman. The stone cuts more freely with the wedge, and can be shaped by the hammer with much greater precision and effect, when wrought with the 'bed', than when attempted in a direction transverse to it. This 'bed' or plane of easiest cleavage bears no traceable relation to the natural joints of the rocks, which are very indefinite in their directions; still less is it referable to stratification. It is rather analogous to the cleavage of the slate rocks, and its direction in the rock is generally vertical.

The grey and blue rocks found in this locality, and popularly described as granite, are still more various in their characters and compositions. Taking the hard, dense, close grained stone of Cairngall as a type, specimens could be found graduating on the one hand into a true stratified gneiss, and on the other into a crystalline limestone of considerable purity; felspar being often entirely replaced by lime. In facility of working they also differ much; the Cairngall stone, and some of the limestones, being quite as obdurate as any of the red granites. A light coloured bluish white stone found at Pitsligo is wrought, when recently taken from the quarry, with greater facility than even some of the Scottish sandstones. It is clean looking, and stands the weather well, becoming much harder by exposure; but the want of railway communication prevents its being used at any distance from its own locality. These grey coloured stones are but slightly affected with cleavage, being capable of being 'blocked' with the hammer with about equal facility in every direction. The red and grey stones are occasionally met intermixed; and patches of the grey are found in the substance of the red, and solidly united with it. The converse of this is very rarely, if ever, seen. More than once, however, a piece of real stratified gneiss has been observed in the interior of a block of red granite. This and other indications pointing in the same direction, seem to suggest that the red granite, often called the primary rock, is in this locality newer than the superincumbent gneiss, and has been erupted through it; the presence of the grey granite being considered as a trace of its metamorphic action upon the original gneissic floor.

D. F.

For about two hundred and fifty years the working of granite quarries about Aberdeen has continued for building purposes, at first only to a limited extent. About the year 1764, the durability of Aberdeen granite being ascertained, it was recommended for paving the streets of London; and in the course of

about thirty years stones of larger dimensions were supplied. From Rubislaw, the first known quarry, now the property of Messrs. John Gibb and Son, stones were furnished for the Portsmouth docks, Bell Rock lighthouse, etc. About the year 1820, principally under the advice of Sir John Rennie, large quantities were supplied from various quarries for the balustrade of Waterloo bridge, Sheerness docks, the upper side of London bridge, etc.; and its durability and clean appearance having yearly increased the demand for its use in carriage ways, paving, curb, pitching, and engineering purposes of all kinds, there are now numerous quarries; among the principal of which are Rubislaw, Dancing Cairn, Sclattie, Tyrebeggar, Kemnay, Cairngall, etc. Paving, and such work used in the streets of London, are all prepared in the quarries. They were used for a considerable time with little work upon them, so that the streets were rougher than at present, and required more repair. About the year 1820 the Institution of Civil Engineers considered the subject; and, after several improvements, the form at present introduced is a thin cube about 9 ins. in depth, 3 ins. in thickness, and not exceeding 18 ins. in length, fair dressed throughout, and the top not kept too smooth.

The introduction of the various coloured granites of Aberdeenshire for architectural works and for general purposes is due to Mr. Alexander Macdonald of Aberdeen, who about 1822 reduced to practice the difficult problem of giving any required form to so stubborn a material, and communicating to its surface an exquisite and enduring polish. In this climate, the effects of rain, sudden frosts, and succeeding thaws, are soon perceptible on marble and other softer materials. The polished granite of Aberdeenshire has retained its polish and rich colour most perfectly under all atmospheric changes, and does not contract any stain from vegetation. It can be shown that Aberdeenshire granite never decays in any appreciable degree; for on the oldest specimens, which must have been taken from outcrops or stones on the surface several hundred years back, and therefore a very inferior material, the marks of the workmen's tools are quite perceptible. The energy of Mr. Macdonald led to the development of the manufacture from costly ornamental articles, and for many years the firm of Macdonald and Leslie assisted in making it one of the most important branches of industry in the north of Scotland. The material has found its way into all parts of the world; and as its durability has been fairly tested in all climates, it is getting more and more into universal demand. From the red granite quarries on the hill of Stirling-hill near Peterhead, situate about thirty miles from Aberdeen, the shaft of the duke of York's column in Waterloo-place; the pillars in Fishmongers' hall; and the columns for the king's library, British Museum, were supplied when the quarries were first opened. The work for the British Museum was taken from the Longhaven quarry and sent up to London in the rough state about 1830, at an expense perhaps ten times above what it would now cost; the columns were then wrought and polished by hand. Finer specimens of the polished red Peterhead granite will be seen in the exterior columns of the Carlton Club, Pall Mall; those in S. George's hall, Liverpool; in the Museum of Practical Geology, Jermyn-street; and the pedestals for the antiquities in the Egyptian gallery of the British Museum.

The grey or blue granites of Aberdeenshire are partly supplied from the quarry of Rubislaw, but principally from Cairngall, which is more of a syenite than a granite, a clean blue finely grained material, and used for the finest work. In grey granite several specimens of portrait sculpture have been executed, as the colossal statue of the duke of Gordon in the public square of Aberdeen; Sir Charles Napier at Portsmouth, etc.: the principal care that the artist has to take in modelling the figure is to remember the hardness of the material to be used, and to treat his details accordingly. From the quarry

of Cairngall the sarcophagus for H.R.H. the duchess of Kent was furnished; and Her Majesty has commissioned the sarcophagus for the royal mausoleum at Frogmore to be made of this material.

The granite in Aberdeenshire principally lies in irregular masses, with seams in all directions, in most cases from east to west and the dip to the north: there are rocks with nearly horizontal seams or 'joints', and almost all the quarries are composed of 'liver' stone, that is, it splits in any direction; but there is much rock of inferior quality, owing to 'dries', bad colour, quarry shakes, or other imperfections. Granite, with all its seemingly closeness of texture and obduracy, has even in the finest specimens a distinct cleavage, discernible to the experienced quarryman. This knowledge of course is useful to him in hammering or splitting a block. The masses of rock are refit from their 'beds' by forming 'bores' of the necessary length from 10 to 30 ft., by means of steel 'jumpers' applied by manual labour; these holes are charged with the proper quantity of gunpowder, which is exploded by means of a fuze. After the unshapen lumps of rock are dragged into the 'floor' of the quarry, the 'cutters' shape the stone roughly by driving soft iron wedges into holes made on the line of intended fracture, placed about 5 or 6 ins. apart; after this a final shape is given to them by a heavy 'pick' about 20 or 25 lbs. weight, before transit to works or elsewhere, by the quarry masons, who leave the stone 'scappled'. 'Fine axing' or 'dressing' is effected by means of picks, or iron hammers pointed at each end, and tipped with cast steel tempered to the proper degree, which leaves the surface out of 'twist', but comparatively rough; the finer surfaces are made by means of the single and double axe; and for joints and moldings steel chisels and 'puncheons' of various sizes are used. The double axe is a framework of iron containing at each end about half a dozen steel blades, forming in combination a dressing surface of about 3 ins. in length, and which leaves the stone in the finest state of dressing possible. An attempt to apply machinery to the dressing of granite has been made, but as it requires a distinct blow to separate the parts in beginning to work it, the result has not been successful as yet. In polishing, which is the next process, different forms of machines are employed. For flat surfaces, concentric grinders of iron are used, applied to the surface of the stone, first with sand and water, then emery, and lastly by the intervention of 'lapp', a thick felt substance, and oxide of tin. All circular work is polished in turning lathes by traversing iron polishers fed continually with the usual materials. In this way columns thirty feet in length, and vases fifteen feet in diameter, are polished on the same principle as smaller ones. Moldings are polished by means of planes fitted to their curves, applied by a lateral motion in a machine naturally called a 'rubber'. Certain concave and convex surfaces have to be polished by hand, such as groundwork of ornament, and any minute sunk work. Granite is cut up into thin slabs by means of saws set in an iron framework, probably twelve at a time; but this is a tedious and expensive operation.

The labour in quarrying and working granite is more tedious than those unaccustomed to the material can imagine; the manufacturers are thus sometimes unable to finish the work in the time many professional men allow. It is suggested that when the introduction of granite in any building is determined upon, the manufacturer should be early communicated with, so as to allow as much time as possible for the work to be done in. The experience of many years warrants these remarks, as the formation of the rock in the quarry cannot be controlled; and, as the working operations are tedious, the necessary time must be allowed.

The local varieties of worked Aberdeenshire granite are as follows, the terms differing somewhat from those used in England.

1. *Hammerblocked*; used for basements, foundations, etc.

2. *Scappled* blocks; squared with the heavy pick; used for docks and heavy engineering work.

3. *Picked*; a better finish than No. 2.

4. *Close picked*; the bed and arrises made fair, and the outer surfaces made as fine as the pick will make them; used for ashlar, etc.

5. *Single axed*; a finer finish than No. 4, and used for the corners, rebates, cornices, etc., in house building.

6. *Fine axed*; the finest finish given to dressed granite by means of the *patent axe*; used in the best work in house building, for cemetery memorials, and as a finish to contrast with polished work. **GRANITE AXE.**

In Aberdeenshire stones of very large size can be obtained; and red and grey columns, such as those in the exchange of Riga, and part of those in S. George's hall, Liverpool, have been furnished of twenty-five feet in length in one block. Works are readily executed composed of blocks from five to ten tons in weight, and, when required, larger stones can be given. The hardness of granite enables joints to be so closely made, that they are barely perceptible; and in columns of large size, when made in pieces, the frustra can be so well put together that the entasis is made perfectly true, without a wrinkle when examined by reflected light; and if the granites are selected carefully as to shade, the joints can hardly be traced. Very pleasing effects can be made by the contrast between the 'polished' and 'axed' surfaces, as the natural rich colour of the granite only comes out in the polishing, while the dressing forms a background. Many architectural features can be rendered in a telling manner by this arrangement, such as scrolls, coats of arms, panels, and other purposes in ornamental and decorative art.

In treating granite, the first point to be borne in mind is, *that it is granite*; that its beauty is shown best in mass and simplicity; its warm colour and enduring finish being its recommendations. Bold ornaments have good effect: much money is thrown away in details more suitable for softer materials, and the appearance is not adequate to the expense. Plain work, such as columns, are obtained at a reasonable cost, as is evinced by the extending demand for such work; plain shafts from 4 ins. diameter are much used. For sepulchral memorials granite is used in an infinite variety of forms, equally varying in cost.

Aberdeenshire granite gives from 13 to 14 cubic ft. to the ton, according to the variety or density of the grain. Its bearing power is enormous when resisting the pressure perpendicularly, as a small shaft about 5 ft. long and 4 ins. diameter will bear many tons. In such work as lintels over an opening it will carry considerably more weight than other stones, but as yet experiments have not been made to determine the limit. It has been found quite impracticable to give a price list for granite work, as so much depends on form and size of stones, and amount of dressing and polishing. Quarried stones cost from perhaps 3s. to 8s. per cubic foot; plain dressing from 4s. to 6s. per superficial foot; plain polishing from 4s. to 6s. per superficial foot; plain circular polished shafts of suitable lengths, 5 to 10 ins. diameter, cost from 16s. to 24s. per lineal foot, etc. All plain work comes very reasonable, but minute detail is expensive as well as unsuitable for the material. Taking a Doric column, for example, the shaft including the fillet and astragal would cost say £40; the base and capital, though not having one-fifth of the cubic measure, would cost together as much as the shaft; this is given as a comparison between plain and minute work.

A. M.

Argyleshire, although abounding in mountains containing every variety of granite, has only within the last twenty years been opened up and made known, chiefly through the enterprise of Mr. W. Sim of Glasgow. The quarries possess numerous natural advantages over those in Aberdeenshire, in so far that in the latter district the granite has to be sought for in inland

situations by sinking quarries to considerable depth beneath the surface of the earth, involving much difficulty and expense in the general working arrangements; while in the former any extent of quarry face can be obtained close to the side of, and parallel to, the numerous lochs and bays with which Argyleshire is intersected. The following list describes all the quarries yet opened.

Furnace quarry is situated upon the banks of Loch Fyne, about eight miles west from Inverary, upon the property of the duke of Argyle. The rock is more of the syenite or porphyry character than that of the true granite. It is highly crystalline in structure, is remarkably hard, and exists in great masses indeterminate in form, being so wedged and dovetailed together as to necessitate its being quarried by means of a system of mines with charges of gunpowder of from two to five tons, bringing down twenty to fifty thousand tons of the rock at one explosion. It has been extensively wrought for the manufacture of square dressed paving stones, many thousand tons of it have been used for paving the streets of Glasgow; for this purpose it may be said to be almost indestructible, in so far that the stones which were laid down twenty years since, although exposed to the tear and wear of great traffic, appear as perfect as at first.

Bonaw Island quarry is situated on the south bank of Loch Etive, about twelve miles south-east from Oban. This quarry is a most excellent large grained grey granite, from which blocks of any size are readily procurable; it has been used for the harbour works at Glasgow, and for the grand flight of steps in the west end park in that city.

Bonaw Causeway quarry is situate a short distance from the above, on the same side of Loch Etive; the granite is remarkably fine grained, but not being obtainable in large blocks it is wrought chiefly for the manufacture of square dressed stones for street paving. It possesses a remarkable degree of hardness, which, combined with its granular character, makes it exceedingly valuable as a safe paving stone. The street paving executed with it in Glasgow has stood the tear and wear of twenty years, and appears as good as when first laid down.

Ardsheal granite quarry is situated on the bank of Loch Linnhie, about twenty-five miles north-east from Oban, and four miles from Ballochulloish slate quarries. This is an excellent quarry of grey granite for general purposes; the formation is so regular as to give it a semi-stratified appearance; it is easily quarried in layers of any required length or breadth, and varying in thickness from six inches up to three feet. It has been extensively used for harbour works; for the gun platforms of Fort Matilda on the Clyde; for kerb crossing; and for paving stones. There is a peculiarity in its component parts which renders it less noisy and more safe as a paving stone than the generality of granites employed for that purpose.

Ross of Mull granite quarries are situate on the property of the duke of Argyle on the island of Mull, in what may be termed a most wonderful granitic region. These are noticed in the succeeding communication.

The only quarries in the south-west of Scotland are the following.

Kirkmabreck quarry is situate in Kirkcudbrightshire, about one mile west from the village of Creetoun, and adjoins the banks of Wigton Bay. This quarry has for many years been extensively wrought to procure the granite for the formation of the Liverpool docks, for which purpose it is admirably adapted, as well as for ornamental or polished works; a good specimen of this silver-grey granite was exhibited in the obelisk sent by Mr. Sim to the Industrial Exhibition of 1862. Blocks of any size are readily attainable.

Dalbeattie quarry is situate about thirteen miles south-west from Dumfries, and has been extensively wrought for general purposes, dock works, kerbing, etc., and latterly for ornamental and polished work. It is a large grained grey granite, and

ARCH. PUB. SOC.

takes high polish, but there is a difficulty in getting large blocks of it free from black marks. CRAIGNAIR.

General Remarks. The growing demand for granite has led to great improvements in its manipulation; formerly the pick was the principal instrument used by the masons in bringing any piece of material into form, now it is rarely employed except for rough work. Trained workmen have become so expert in the use of the hammer and chisel, as with these to be able to execute any work in granite, however delicate. Besides its use in basements of buildings, and for external decorations in building, it is now freely employed in the form of polished shafts for columns, for pilasters, and in doorways. Many examples may be seen in London and Liverpool; and with the ready command of good granite in combination with bronze or fine metal for delicate ornamental work, there is every reason to expect that the entire fronts of buildings will in many instances be completed with this imperishable material. W. S.

The granite put forward by the Ross of Mull Granite Company is obtained from a wild hilly district of about fifty square miles, at the south-west extremity of the island of Mull, and just opposite the celebrated Iona; the whole of the shore line for more than twenty miles, and the numerous rocky islets by which it is surrounded, consist entirely of this material; the masses in which it is found, or as they are called, the posts, are in many places of enormous dimensions; that which was examined, and at one time expected to be selected, for the monument to the late Prince Consort, is at least 116 ft. long and 12 ft. square, and there are many other posts equally large. For the purpose of description, the granite may be divided into two sorts, the red and the pink; the felspar on which the colour depends being in the former of a brilliant red, and in latter of a delicate pink, tint. There are two large quarries of each description, viz. Tormore and Bull Hole for red granite, and two quarries at the North Bay for pink granite: they are all on the sea shore so that the vessels for shipping the granite come close alongside, and are together capable of producing about 5,000 tons a month. In its physical character the granite most closely resembles that from the quarries in the neighbourhood of Aberdeen, the grain being very close and even in texture, and the felspar of the most insoluble variety; there is nothing in the district at all resembling those specimens of granites that so readily yield to decomposing influences and produce the china clays. The red granite is sent in large quantities to the polishing works in Aberdeen, and bids fair eventually to supersede the celebrated Peterhead granite entirely, owing to the difficulty of getting large blocks in the Peterhead quarries. Polished blocks of the red and also of the pink granite have been largely used in many places; and in the mausoleum of the Prince Consort at Frogmore, the rough stones having been conveyed from the quarries to Mr. Sim's works at Glasgow, where they were wrought and polished ready for fixing. With regard to heavy masonry, the granite was used for the construction of the Skerryvore lighthouse, being selected by Messrs. Stevenson; also in the Liverpool docks; the docks at Londonderry; the Glasgow waterworks, etc. The pink granite was used during the early part of the work at the new Westminster bridge, in the foundations, for which purpose it may have been selected on account of its durability, in which respect it resembles the Aberdeen granites, while large blocks are obtained as easily as in Cornwall. The Tormore or red granite was used for the curb to the footways. It is now supplying the material for the extensive harbour works in progress at Greenock, near the mouth of the Clyde. It is worked and polished in precisely the same way as the Aberdeen granites.

M. H. J.

The following notes on granites have been extracted from WILKINSON, *Practical Geology, etc., of Ireland*, 8vo., London, 1845. "The ordinary colour of the Irish granite is a speckled

grey inclining to white, as Wicklow, Dublin, etc.; also greenish from hornblende, as Mourne, Newry, etc.; reddish, as Galway, etc. The most extensive district stretches south from Dublin, through the counties of Wicklow and Carlow into Kilkenny. On the south-eastern coast of Down, and around Newry, the range of the Mourne mountains, is granite, which again occurs in smaller and isolated protrusions in Derry and Tyrone, and in Cavan. In the western portion of Donegal there is a large extent of this rock, which here partakes of a gneissose character; and, again in the west of Galway, granite covers a considerable area. The granite of the Wicklow range is used more extensively than that of any other district in the island. It varies considerably even within a limited distance; near Kingstown it is very hard, the quartz predominating, and is seldom used for any but plain and heavy work; buildings in this neighbourhood which require more ornamental work being erected with granite of an easier working quality, brought from Ballyknocken or Golden Hill, a distance of twenty miles. This stone contains a larger proportion of felspar and less quartz than that of Kingstown, and is also of a lighter and more uniform and handsome colour, though less durable. The granite in the Carlow portion of the same range is similar. The granite of Down is generally of a darker colour, and more finely crystallized; it is extensively quarried in several places, particularly at Newry, from whence it is conveyed by water to several parts of the north of Ireland. It can be worked into fine moldings, and is of a dark speckled colour. The Galway granite is commonly of a reddish colour, containing large crystals of flesh-red felspar; occasionally it has a bluish tint. To the west of Clifden in Omev, it is of similar character, and adjoining the coast it has much of a stratified form, from which blocks of moderate thickness, but great length and width, can be obtained. This county affords a very great variety in the colours and composition of the granite, and much of it would produce a very beautiful effect if polished. The granite to the west of Mayo, on the coast of Belmullet, much resembles that to the west of Clifden; the greater part of the granite, however, in the county of Mayo, is of a dark bluish-grey colour, and of a gneissose character, difficult to work and seldom used. In Donegal, as above remarked, the general character of the granite is gneissose, and being difficult to work, and other rocks being more convenient, it is not much used. The granite in Tyrone possesses a metamorphic gneissose character, is of a reddish tinge, and very little used. That in the county of Cavan is of the ordinary granitic character, similar to the granite of Down, occupying a limited area, and is also very little employed. In the counties of Kilkenny and Wexford, it generally resembles that of the great Carlow range before remarked on, to which it doubtless belongs."

Experiments on granite 14 ins. long, with a bearing of 12 ins. and 3 ins. square; and on cubes of one inch sides, are given at the end of the work. Irish granite averages 170 lbs. per cubic foot, its extreme weights being 143 lbs. and 176 lbs. After eighty-eight hours immersion in water, it was found that a cubic foot of the granite of Newry and Kingstown absorbed about a quarter of a pound; that of Carlow nearly 2 lbs.; and the granite of Donegal 4 lbs. of that fluid. The granite of Ireland has not yet supplied works much beyond its own localities.

In the neighbourhood of Bagnalstown, in the county of Carlow, the granite is of four different descriptions.

1. The granite used for building plain houses, public works, railway bridges, etc. It is cleft by wedges from rocks on the surface of the land, varying in weight from 1 cwt. to 20 tons. Some portions are very hard, and others very soft; some have a very fine grain, while others are coarse in quality. This granite varies in colour, being red, grey, brown, and blue.

2. There are several solid quarries of a fine grit; this stone has been used for ornamental work, as at the mansion of P. J. Newton, Esq., Dunluray, near Bagnalstown, lately built in the

most elaborate Gothic style. The material is very durable, and is of a very white colour.

3. Another and a large quarry consists of a granite not quite so fine in grain as the last mentioned, but much used in house building. It lies in horizontal beds of about 12 ins. to 15 ft. thick, and from 15 to 20 ft. wide; some beds run 40 ft. long; it is very white in colour. This quarry has supplied granite for all varieties of ornamental work for buildings, tombs, vases, etc.; the dressings of four large mansions for the Messrs. Malcomson of Portlaw, co. Waterford, built in the most elaborate Italian style from the designs of J. S. Mulvany; the dressings for the new Molyneux asylum at Dublin; for several church towers and spires, as at Bagnalstown, etc.; and the heavy coping for the battery at Dale blockhouse, South Wales: in the hall of the Oxford University, set in the floor for inlaid inscriptions, is a slab of this granite about 10 ft. long, 5 ft. wide, and 7 ins. thick. A cube foot weighs 1½ cwt., and absorbs 4 oz. of water when steeped for eighty hours.

4. A quarry of a very hard granite supplies the stone for the street crossings at Cork, Skibbereen, and many other places, under the care of the Cork corporation.

All these granites can be forwarded either by railway or canal. It has been sent to Newfoundland; and is greatly approved for long terrace steps, many of which have been forwarded to various parts of Ireland in single stones from 6 to 15 ft. in length. The granite liable to wear or suffer from the atmosphere will be found to be a soft rotten stone with a large quantity of quicksilver therein. Plenty of good sound material is to be had; and it is remarkable for making good floors in stores and gentlemen's kitchens, porches, and halls, as it holds dry in damp weather by the very act of absorbing the moisture which in other cases would condense against the windows and walls. It is also much used for paving military and other stables for the above reason, and also that horses are not liable to slip or fall thereon.

B. D.

Granite for use in paving purposes is imported into London in very large quantities: For *curbs and trams*, from Guernsey, Jersey, Aberdeen, and Devonshire. For *pitching*, from Aberdeen, Mountsorrel, Markfield, Groby, Guernsey, and a small quantity from Wales. For *Macadam roads*, from Guernsey, Mountsorrel, etc. The granite from Herm, near Guernsey, has also been used to some extent. The steps to the Duke of York's column, S. James's Park, are of this material; but the cost of working and the difficulty of shipping it at the quarry, have led to the discontinuance of its use. The Aberdeen granite is the most extensively employed for curbs, trams, and pitching; the quality being best adapted for the London purposes, being very durable, and less slippery than most other granites. The Devon granite is coarse in grain, and used only as curb for second rate streets. The pitching made from it cannot be produced to compete in price or quality with that from Aberdeen; the material being altogether better adapted for building purposes. The quarries of Leicestershire now supply the London market with pitching and macadam, from Mountsorrel, Markfield, and Groby; the former being red in colour, the two latter dark green. All the principal macadamized thoroughfares are maintained with granite from Guernsey broken into pieces 1½ to 2 ins. square; it is by far the best material for the purpose; one coat, if properly applied, will last two of any other granite. When used for curbs or pitching, this granite becomes slippery, and is therefore seldom adopted. The Welsh granite recently introduced has the same fault.

BURGOYNE'S treatise, above noticed, also contains the following useful table of experiments, made under the direction of Mr WALKER, on the wear of different stones in the tramway in the Commercial-road, London, from 27 March 1830 to 24 August 1831, being a period of seventeen months. This road-way consists of two parallel lines of rectangular tramstones

18 ins. wide by a foot deep, and jointed to each other endwise, for the wheels to travel on, with a common street pavement between for the horses. These tramstones were laid in the gateway of the Limehouse turnpike, so as of necessity to be exposed to all the heavy traffic from the docks.

Table of Experiments.

| Name of Stone | Sup.
area in
feet | Original weight | Loss of
weight
by wear. | Loss
per sup.
foot | Relative
losses |
|-----------------------------|-------------------------|-----------------|-------------------------------|--------------------------|--------------------|
| | | owl. lbs. | lbs. | lbs. | lbs. |
| Guernsey | 4.734 | 7 1 12.75 | 4.50 | 0.951 | 1.000 |
| Herm | 5.250 | 7 3 24.25 | 5.50 | 1.048 | 1.102 |
| Budle (species of whin) ... | 6.336 | 9 0 50.75 | 7.75 | 1.223 | 1.286 |
| Peterhead, blue | 3.484 | 4 1 7.50 | 6.25 | 1.795 | 1.887 |
| Heytor | 4.313 | 6 0 15.25 | 8.25 | 1.915 | 2.013 |
| Aberdeen, red | 5.375 | 7 2 11.50 | 11.50 | 2.139 | 2.249 |
| Dartmoor | 4.500 | 6 2 25.00 | 12.50 | 2.778 | 2.921 |
| Aberdeen, blue | 4.823 | 6 2 16.00 | 14.75 | 3.058 | 3.216 |

A. C.

The above communications have been kindly forwarded by the several quarry proprietors and others; a few more were expected, but have not been received. In the journals may be noticed papers by R. H. SCOTT, *Granite Rocks of Donegal*, read at the British Association in 1861, and partly given in the DUBLIN BUILDER *Journal*, 631, 677; JOHNSON, *Description of the Railways, etc., in the Granite Quarry at Dartmoor, and the Mode of Working*, read at the British Association in 1841, and given in the CIVIL ENGINEER *Journal*, iv, 322; Sir G. WILKINSON, *On the Use of Granite*, given in *BUILDER Journal*, xviii, 395, which also gives, p. 183, BELL, *Art Treatment of Granitic Surfaces*, read at the Society of Arts, etc., 14 March 1860; p. 132, BURNELL, *Causes of Decay in Building Stones*, read at the same Society, April 1860; and p. 836, *Granite Export of Guernsey*; ix, 588, *Remarks on Granites of Cornwall and Devon*; with, 605, those of *Scotland and Ireland*. The *Relative Cost of Masonry* is given in the CIVIL ENGINEER *Journal*, 1844, vii, 299; KANE, *Industrial Resources of Ireland*, 8vo., Dublin, 1845. A work appears to be still wanting to describe the granites of each country, and their uses in building; the following consist of a few notes towards this object.

Granites, including syenites, used by the ancients.

Lapis Pyropiscilus, or *Granito Rosso*, is of various shades of red; the felspar is of a fiery red colour variegated by a lighter and deeper shade. It was obtained from Upper Egypt, in the vicinity of the first cataract of the Nile; PLINY, *H. N.*, lib. xxxvi, cap. 8. The twelve obelisks in Rome (except that of Aurelian on the Pincio) are of light red, almost rose, colour. The columns of the Pinacotheca of the Baths of Diocletian, now the church of Sta. Maria degli Angeli, are of a deeper shade. The monolith 74 ft. high, at Alexandria in Egypt, called Pompey's Pillar, is also of this material.

Lapis Pæronius, *Granito del Foro*. The base is the very whitest quartz speckled with a very large proportion of black mica, like the plumage of a starling, and very little felspar scattered regularly in little round dots. The columns of the basilica Ulpia and of the Forum of Trajan are of this granite.

Lapis Syenites or *Granito Bigio* (*Granitello Antico*) is composed of grey and white particles containing very little mica; it was more used by the Romans than any other granite.

Lapis Ethiopius, *Granito Nero*, was much used in Egypt for statues, etc.; it may be mistaken for basalt.

Lapis Judaicus, *Granito Grafico*, has crystals of dark coloured or black quartz imbedded in livid white felspar, so as to appear like Hebrew characters. It is found in the Tyrol and Siberia.

Lapis Ligusticus, *Granito del Genoa*, is more properly a serpentine.

Granito Bianco e Nero is formed of equal proportions of white felspar and black hornblende in large round spots.

Granito Verde is very rare and valuable.

Granito della Sedia, of a very dark green colour, is irregularly speckled with small particles of white quartz.

Granito della Tebaida, or *ad Erbetta*, has a base of dark green covered with minute crossed lines of light green colour.

Granito del Isola del Giglio (*Iglium*) is grey in colour, composed of felspar, quartz, black mica, and small deep green particles of hornblende or serpentine.

Granito del Elba, *Granitello*, is light grey with very small speckles of black

mica. Probably the greater part of the grey granite used by the Romans was brought from Elba, where quarries were worked at a very early period. The quarries of S. Pietro in Campo, in Elba, supplied the columns used in the cathedral and baptistery of Florence: the grand duke Cosmo I. caused a large block to be cut into a basin measuring nearly 66 ft. in circumference, which was placed in the gardens of the Pitti palace. The celebrated single block in the Duomo at Ravenna is said to be of the same granite; it was the largest example of the use of that material in modern times until the erection of the statue of Peter the Great in S. Petersburg, the pedestal of which is of the red granite of Ingria.

Minute details of the several varieties are given in CORSI, *Pierre Antiche*, 8vo., Roma, 1833, and abstracted in HEAD, *Rome*, 8vo., London, 1849, i, App. B.; BEARD, *Traité des pierres précieuses*, 8vo., Paris, 1808; and *Minéralogie*, 8vo., Paris, 1821, which notices the principal granites of Europe.

A. C.
The four columns of red oriental granite in the hall of Apollo, at the Musée Impérial, Paris, were taken from the tomb of Charlemagne.

Charles VII (1735-59) or Ferdinand IV (1759-1825), king of Naples, as heir to the Farnese family, sold four columns which adorned a saloon of the palazzo belonging to that family at Rome, and which were said to be of *Egyptian granite* removed from the ruins of the golden house of Nero. It was afterwards found that one of the shafts was of white marble stained to correspond with the others; but a fourth was procured from the Baths of Titus, and they were formed into a tetrastyle monolithic portico at Lyons in Kildare, the seat of Lord Cloncurry; NEALE, *Views*, 2nd series, 4to., London, 1825, ii; these are of different shades of red colour, with about one-fourth part of the surface consisting of black spots, and not the grey EGYPTIAN GRANITE. They are 12 ft. high and 6 ft. in circumference, very highly polished, and have not suffered after an exposure of forty winters.

The following are a few notes of the foreign granites. In the United States of America, granite abounds in the New England states, especially in New Hampshire and Massachusetts. A beautiful white granite is there quarried and employed in building, and sent to distant parts of the Union. The United States bank at Philadelphia; the market house at Boston; some houses at New York, with other buildings there and elsewhere, are of this granite. The syenite, often called granite from its resemblance to it, is even more difficult than granite to chisel for ornamental work. The fine quarry at Quincy near Boston has given to it the name of 'Quincy stone', by which it is generally known. The Astor house at New York; the Bunker-hill monument; many structures in Boston; and the Harvard university at Cambridge; show that it bears exposure to the air without injury to its appearance; TUTHILL, *Hist. of Arch.*, 8vo., Philadelphia, 1848.

In Russia, the columns in the interior of the new church of Our Lady of Kazan at S. Petersburg, are fifty in number, and each of one piece of granite from Finland, 40 ft. high and 4 ft. in diameter, surmounted by a rich capital in bronze, with a base of the same metal. The granite has a general reddish brown tint, sparkling with mica and felspar, and resembling Egyptian syenite; and though said to have been very finely polished, the lapse of fifteen years has made some havoc on its surface, which appears abraded in various places and decomposing; GRANVILLE, *Guide*, etc., 8vo., London, 1835, ii, 185. The granite generally used in S. Petersburg is obtained at 125 miles from the city; it is solid, unalterable, and as fine as that of the islands of Giglio and of Elba: it resists the attacks of the seasons, and receives a very fine polish. The black granite obelisk erected by Brenna was obtained from Serdopol; while the red granite pedestal for the statue of Peter the Great was a boulder found near the village of Lacta, twenty-five miles from S. Petersburg. For the church of S. Isaac in the same city, erected by Montferrand (1820-47?) the granite was obtained from quarries situate in two small islands on the shores of the gulf of Finland, between Viborg and Frederiksham; they supplied the forty-eight monolithic blocks for the shafts of the columns of the portico; these shafts, 56 ft. long and 7 ft. in diameter in the rough, were finished at S. Petersburg to 45 ft. 6 ins. high and 6 ft. 6 ins. diameter. Next in size to them are the twenty-four monolithic shafts of the tambour of the dome, each 42 ft. high, weighing nearly 66 tons, and placed at a height of 150 ft.

X

from the ground: there are also thirty-two monolithic columns to the towers.

In *France*, the red granite of the Vosges mountains is a mixture of rose, grey, and black, resembling Egyptian rose granite. The green granite has grains of dark green, greenish white, and black, very fine. The nankin granite is a kind of nankin marble, with small lenticular grains; CLARAC, *Musée du Louvre*, 8vo., Paris, 1841, given in *CIVIL ENGINEER Journal*, ii, 453. Black granite is obtained from near Brest; red from Nantes in Brittany: the granite from Laber and Kersanton, Finisterre, was used for the pedestal for the Luxor obelisk at Paris; and for the fountain, erected 1862, at the eastern entrance of the Champs Elysées, the basin is 11 ft. 2 ins. diam., and made out of a single block which weighed 24 tons 12 cwt. The grey of Chessi (Rhine), and of Thain, near Lyons; the graphic granite of Autun; the graphic granite, the orbicular, and the grey of Lavezzi, all of Corsica, present other specimens.

In *Sweden*, the extensive quarries in the island of Malmö, on the west coast, furnish granite remarkable for the extreme fineness and closeness of its grain, and the delicacy of finish which its texture permits; it bears a high polish.

In *Spain and Portugal*, granite is extensively used for building purposes, with a facility of execution unknown in this country. A few observations are given by BURNELL, *Orense*, in *Galicia*, in *Transactions of Royal Inst. of Brit. Architects*, 1852-3.

In *Italy*, besides those mentioned among the ancient granites, the pink granite of Baveno, on Lago Maggiore, is used at Turin for monolithic columns of large size; COLLEGO, *Elementi di Geologia, pratica et teorica*, 8vo., Turin, 1847.

In *Egypt*, it is a remarkable fact that, while the temples in the Delta were built chiefly of granite and with monolithic pillars, the use of this material in Upper Egypt was confined to adyta, doorways, obelisks, and statues; the sandstone being there preferred for the walls and columns; and these pillars are consequently formed of several blocks. But wherever the Egyptians used either the granite or the sandstone, they put into practice their knowledge that both materials were inferior to limestone in one respect, viz. that the latter might be buried without risk of its being corroded by the salts of the earth; WILKINSON, *Handbook for Egypt*, 12mo., London, 1847. Abdallatif, and Makrizi, another Arab writer, describe a green chamber in the ruins of Memphis of a single stone, of that hard granite which iron cannot cut; it was broken about the year 1649, and pieces were to be seen in the convent founded by Emir Seif-eddin Scheikhon Omari, and in his mosque outside Cairo: this stone was probably made of a species of green granite, sometimes confounded with green porphyry; Soc. FOR DIFF. OF USEFUL KNOWLEDGE, *Egypt. Antiq.*, 8vo., London, 1832, i, 197.

GRANITE (ARTIFICIAL). A manufactured stone so called, invented by J. Bazley White, and said to consist of Portland cement driven into intimate contact in iron moulds with fragments of Portland stone, by sharp and often repeated blows; and the union of the two materials is the more remarkable, because it can be effected almost in a dry state, and with scarcely more water than is given out by the stone in the process of percussion. The uses of such a material, which is made to take any shape according to the moulds employed, are obvious—pipes, sewer-blocks, landings, pavements, and even walls, are some of the applications which have been made of it by the inventor, who has found it wear as a pavement in some very exposed situations, superior to that of Yorkshire stone. Paper read at Inst. of Civil Engineers 12 May 1852, *On Artificial Hydraulic, or Portland, Cement*, p. 15. Another artificial granite is described s. v. D'HARCOURT.

GRANITE AXE. An American invention, the patent for which expired about 1839, often called by workmen a 'Patent Hammer'. It was first introduced into Scotland by provost James Nodder of Aberdeen, who got it over from New York

about 1835, and is now used to put the finest 'axing' or 'dressing' on granite throughout the country. It consists of an iron framing or hollow hammer head with from five to eight steel blades bolted into each end, so that all the cutting edges are parallel, true, equidistant, and of equal length; it is similar to the hew or chare end of the DIAMOND HAMMER, but the cutting edges are nearer together, more easily sharpened by being removable, and produce finer and better workmanship than that tool. *BUILDER Journal*, xvii, 304. BIT HAMMER. R. R. R.

GRANITIC BRECCIA STONE. A company was formed in 1858 for its manufacture under letters patent granted to W. Buckwell about 1848. This stone is said to possess strength, durability, and economy, in the latter competing with brickwork in many constructions, while its strength and durability are greater, and its bulk and weight considerably less. It is impermeable to wet, and never vegetates. This stone can be manufactured in a single piece of a weight varying from 1 cwt. to 60 tons or more; also in slabs from 5 ft. to 100 ft. super., and to any contour of plain or molded face. It is adapted for paving for all purposes; and has been employed as lining to the reservoirs of the dean and chapter of Westminster; in Hyde Park; the large fountain basins in the interior of the Crystal Palace; the vaults and catacombs in the City of London Cemetery at Ilford; in the basement of the extensive warehouses in Beer and Water Lanes, and Great Tower Street; and other places. Some further remarks, tending to prove the employment of this invention by M. Coignet in France, are contained in *BUILDER Journal*, 1859, xvii, 478.

GRANUCCI (BARTOLOMEO), a pupil of L. Vaccaro, decorated the cappella del Rosario in the church of S. Pietro Martire, rebuilt 1734 the church of Sta. Maria de Vertice Celi, and designed 1745 the candelabra in the chapel called the Tesoro di S. Gennaro in the cathedral, at Naples. 95.

GRÃO (JUAN and FRANCISCO) of Manresa, constructed 1661 the pantheon in the Bernardine monastery at Poblet in Catalonia, and executed there the tombs of king Alonso V, the infant Don Henrique, and the viscount Ramon de Cardona. 66.

GRAPHITE, see BLACK LEAD.

GRAPIGLIA (GIOVANNI) commenced 1621 the erection of the church of S. Pietro di Castello at Venice; where his namesake Girolamo, perhaps his father, designed about 1572 the Loredano and Mocenigo tombs in the church of SS. Giovanni e Paolo. 3.

GRASSER (ERASMUS) of Munich built about 1500 the Brunnhaus and the chapel next to it at Reichenhall in Upper Bavaria. 68.

GRASS GREEN. The name applied by ANSTED, *Elementary Course*, 8vo., London, 1850, to the green tint, for which he gives green diallage, malachite, and uranite as the standards.

GRASSI (FILIPPO) of Milan, superintended at Brescia, probably until 1524, the construction of the palazzo della Loggia, commenced 5 March 1492, upon the design of T. Formentone, at the west end of the piazza Maggiore or Nuova; in 1496 he was styled 'architectus ad fabricam palatii—ad rationem soldorum duodecim pl. pro qualibet giurenata'; he had previously (1484-92) erected the buildings on the south side of the same piazza: ZAMBONI, *Memorie*, fol., Brescia, 1788, pp. 32-53.

GRASSI (GIOVANNI) is mentioned as the designer 1678 of the interior of the church of S. Eustachio at Venice, by SELVATICO, *Sull' Architettura*, 8vo., Venice, 1857, p. 431.

GRASSI (GIOVANNI or GIOVANNINO DE') submitted 16 Jan. 1390 designs, for works in the cathedral at Milan, which were reserved for future consideration; was engaged there as a sculptor, and appointed 12 July 1391 one of the 'ingegneri' of the fabric: he was subsequently engaged with J. da Campione in reducing to the limit of expense arranged by the wardens of the fabric J. von Fernach's design for the sacristy;

was appointed 11 May 1392 the principal architect (the execution of the sacristy was ordered 5 August 1393); was selected 11 November 1393 to make the design for the tomb of Galeazzo Visconti in the window at the end of the nave; and was sent 17-24 March 1395 to Pavia, with Ulrich von Fissengen and J. da Campione, to exhibit the designs made by Ulrich. He was buried 6 July 1398.

His son SALOMON was consulted 19 October 1399 as to the completion of the sacristy; and 4 January 1400 was ordered to make the design for the tomb above named. GIULINI, *Memorie*, 4to., Milan, 1771, xi, 445-6, 454. 27.

GRASSI (IL PADRE ORAZIO), born about 1600 at Savona, was employed in that city to modernize the cathedral, and to design the wing of the building on the right side of the Santuario della Madonna di Misericordia. The map of Savona, engraved from his plan, is rare. Having become a Jesuit, the society employed him to combine in one set of drawings the merits of two designs submitted by Zampieri for its church of S. Ignazio, commenced 1626 and opened 1650 at Rome; the design for the façade was obtained from A. Algardi by Grassi, who superintended the construction of the building. He died 23 July 1654, and was buried in that church, which was completed 1685, and is illustrated in FERRERIO, *Nuovo Splendore*, ii, 9; as well as in LETAROUILLY, *Rome Moderne*, fol., Paris, 1825, p. 372, pl. 173; and in ROSSI, *Templa*, fol., Rome, 1684, pl. 26-8, who calls him Crassus; TITI, *Ammmaestramento*, 12mo., Rome, 1686, p. 143. 37.

GRASSI (DE'), see CARPI (G.)

GRASS TABLE, EARTH TABLE, and GROUND TABLE STONE. "Cir. 1693. A Bill of work done for y^e Lord Scudamore by the day at the two ends of the house, below y^e grass table, which comes to £05. 06s. 09d."; BRIT. MUS., *Add. MS.*, 11,046, art. 43. WILLIS, *Nomenclature*, 4to., Camb., 1844, explains W. of Wyrester, "from the grasse (erth) table to the gargyle 126 ft.", as meaning the first slope of a basement.

GRATE. This term, in its original application by builders, meant two or more bars of wood or iron placed parallel to each other, with intervals of space between them; thus, in the north of this island a pair of grates means the front and bottom bars that confine the coals in a fireplace; LOUDON, *Encyc. of Cottage, etc.*, Arch., 8vo., London, 1842, § 888. As it is frequently useful to know the names of grates for the consumption of fuel in an apartment, it may be added that in 1824 it was said that "the loose grates standing complete, without setting in brick, are termed sarcophagus grates; some ancient grates of the same description are termed Stafford grates; others are called cottage stoves; those without sides, but having bars only in front, are called skeleton grates"; and each of these forms is still reproduced, at times, in the present day. A Staffordshire chimney is thus described by FRANKLIN, *Causes*, etc., 8vo., London, 1787, pp. 39-40; "the opening of the chimney is bricked up even with the fore-edge of its jambs, leaving open only a passage over the grate of the same width and perhaps 8 ins. high: the grate consists of semicircular bars, the upper bar of the greatest diameter, the others under it smaller and smaller, so that it has the appearance of half a round basket; it is, with the coals it contains, wholly without the wall that shuts up the chimney". The same author mentions, p. 55, the contrivance of a rotatory apparatus, by which one grate may be turned from one room to another; this plan gave the power of leaving one fireplace empty, and of closing its half of the bottom of the flue. This was not the case in Hiort's circular grate, also intended for use in two rooms, as well as for changing the position of the fuel in regard to the draught; this, again, differed from the rotatory grate patented 1853 by Kendrick, which is merely a round basket working on an upright pivot fixed on the centre of the front of a shell-backed fireplace. A brazier for warming churches is called a grate in the *ECCLESIOLOGIST Journal*, 1846, vi, 177-9. CAT-STONE; DOGSTONE.

ARCH. PUB. SOC.

Amongst the deficiencies with which the present state of science has been reproached, is the fact that it has not yet supplied any rule for the proportion of a grate to an apartment: the reproach is unreasonable; for in this matter, as in the quantity of clothing to be worn by an individual, science cannot successfully interfere. Premising that the back and sides of the firebox should be of fireclay, and not of metal, it would seem that for the sake of domestic comfort, the grate should be as large as those, who are to use it, may think can possibly be wanted: the only means of having an apartment well warmed by an open fire is to have a grate so wide that experience may teach how much fuel can expediently be spared by the introduction of lumps of fireclay at the sides. The following empirical rules are given because they can be easily tested: the grate should have one inch of frontage for every foot in length of the apartment; the width of the back should not be more than half the frontage; the bottom depth should not exceed one inch for every three of frontage; the top depth should be, like the height of the grate, a third of the frontage; the bottom should be solid, and at least a foot above the hearth; and a descending flue is to be preferred to an ascending flue. These rules may be compared with the dicta on the same subject given by TREDGOLD, *Principles of Warming*, etc., 8vo., Lond., 1824, pp. 232-7, viz., that firebrick may be employed with advantage; that the fire will not burn pleasantly where the back is less than 6 ins. from the front; that the bottom grating should slope 1 in. in 6, so as to throw the ashes to the back; that the section of the bars should be that of a wedge pointing to the fire; that the covings should be never blacked, but be either glazed earthenware of light colour (not white), or brass, as better than steel; that the covings should form an angle of 45° with the front; that the back should have an angle in the centre of its plan; that the angles of the plan of the firebox should not be so acute as 45°; that the top bar should be between 20 and 24 ins. from the floor, and between 15 and 16 ins. from the mantel; that the grate should have one inch of frontage for every foot in length of the apartment; that the grate should have half an inch in height for every foot in breadth of the apartment; and that there should be two fireplaces whenever more than 30 ins. would be required in the width of one grate; also that in such cases the same proportions may be adopted, divided into two grates, unless the room be very broad, when a greater length should be given, and less height, so as to preserve an equivalent area. On this subject reference may also be made to ROSSER, *On Open Fireplaces, with Remarks upon their Construction*, in the Transactions of the Royal Inst. Brit. Architects, 1855-6, p. 119. A good proportion was found where the breadth from side to side of the front bars of the grate was 14 ins.; the depth from the top to the bottom bars was 10 ins.; and the width from the inside of the top bar to the back of the grate was 6 ins., but at the bottom 4 ins. as given in *Detached Essay*, HEAT. The distance in a good room between the nearest edges of the grate and the door, if in the same wall, should not be less than 9 ft.

GRATE. A distinction has been made between a grate and a grating: thus an area grate would be the moveable portion or door in an area grating or collection of fixed bars. As a matter of police it would be desirable that every area should have a horizontal iron grating, and even an additional net of wire work. In France *écaille* is the technical term for a grate at the end of a lake or of a drain. Inasmuch as a portcullis is a grate, the term grate (properly grating, Fr. *grillage*), was applied to the framework of timber resembling a portcullis laid horizontally, which served as a foundation, and was frequently called a *brandreth*. At least, although NICHOLSON, *Dict. Arch.*, s. v., explains that term as "a fence of wattles or boards" (perhaps he might have included an upright grating or palisade) "set round a well to prevent the danger of falling in", yet WILSON, in the *ARCHÆOLOGICAL Journal*, vii, 293, supposes the 'branderathes of ye pilers and of the landstathes', men-

tioned in the contract, 1421-2, for Catterick bridge given in the same *Journal*, p. 57-8; and in the *GENTLEMAN'S MAGAZINE*, 1829, xcix, part i, 394, to be 'frames of timber, laid flat, below the bottom courses of stone', and he adds that he had heard 'such a frame, made to support a stack of corn, and set upon large stones to raise it from the ground, in a farm-yard called a brandereth'; which suggests the origin of the term grid or gridiron as applied to the platforms used for lifting ships out of the water. The term 'grillage' has also been adopted in England for the platform of stout framed timber secured to the heads of piles on which the abutment of a bridge was built, the piles being driven in the direction of the pressure, so that the platform laid at right angles to it.

The popular expression, however, for an upright grating continues to be *grate*, as in the case of the vertical partitions in churches, convents, prisons, etc.: a collection of such gratings is given in *VIOLLET LE DUC, Dict., s. v. grille*; and in most works professing to contain examples of ornamental ironwork. *Illustration, s. v. Grille*.

GRATIANOPOLIS, see GRENOBLE in France.

GRAUNGIA, see GRANGE.

GRAUWACKE, called in England Grauwacke or Greywacke. The name given by German geologists to the lowest members of the secondary strata, such as the Longmynd rocks, the Llandillo flags, etc. In its most common form, grauwacke may be described as coarse slate containing fragments of other rocks varying in size from one to three inches in diameter to the smallest grain; in the latter case it passes into common slate; but when the particles are larger, and the slate in which they are imbedded can scarcely be perceived, the grauwacke becomes coarse sandstone. When the fragments are large and angular, this formation may be described as a breccia; when rounded, a conglomerate. Though composed of substances of various colours, it is usually of a greyish tinge (hence its name); sometimes of considerable hardness, and will bear a polish; it is often distinctly stratified, though the stratification is unconformable with that of the subjacent rocks; it is highly metaliferous, the ores occurring both in beds and veins. The greater part of the Scotch mountains north of the Firth of Forth are composed of the grauwacke series. G. R. B.

The grauwacke rock of Ireland seems to be not easily recognizable in its subdivisions. In the north the general grey colour occurs constantly in the grits and slates; while in the south the grits are mostly greenish or brown, and the slates are green, red, or purple. Local peculiarities are mentioned in the *DUBLIN BUILDER Journal*, 1860, p. 278, with an attack upon the inferences in regard to them to be derived from Murchison's Silurian system.

GRAVEDONA (ENRICO DA) occurs under the date 19 Oct. 1399 in the list of architects employed on the cathedral at Milan. 27.

GRAVEL (It. *ghiaja*; Sp. *cascajo*; Fr. *gravier*; Ger. *kies*). The name given to the fragments of stone, or flint, forming small pebbles found in beds which result from the transporting power of water, acting upon a large formation containing those materials in diffusion through its mass. There are therefore gravels of every geological series, and of every kind; from the conglomerates of the old red sandstones to the more recent glacial deposits of the strata superior to the chalk; and the beds differ also in their composition owing to the greater or less proportion of the sand or loam present, or of the argillo-calcareous earth serving to bind together the whole mass. G. R. B.

Gravel in its natural state is found in a firm mass, and even when mixed with a large proportion of sand, it forms a solid base for foundations. A few inches thick of untouched gravel have even been found sufficient for such purposes. It has been ascertained that under the pressure of only three-fourths of an inch of water, coal gas will escape by any leakage in the conduit pipes through a stratum of sand or gravel three feet in thickness in an exceedingly short space of time; this thickness

seeming to oppose scarcely any resistance to its passage to the surface.

Sandy gravel (Ger. *kies-sand*) close trod weighs 120 lbs. aver. per cube foot; but the same filled loose without treading will occupy the space of $1\frac{1}{2}$ cube ft. A cube yard of loose gravel is therefore only three-quarters of a cube yard when trod or settled down; and 27 cube ft. in the pit, will when filled into the cart be equal to 36 cube ft., which is but little more than 22 bushels heaped; *LANGLEY, London Prices*, 8vo., London, 1750.

The white shell gravel used in the London parks in 1846 was brought from the beach on Long Island, New York. The ochry gravel of Belgium in Beejapore is so hard as to approach the nature of stone, and when cut a few feet from the surface is capable of being formed into a natural brick; it is of this substance that nearly the whole town is built; *HAMILTON, East India Gazetteer*, 8vo., London, 1828, i, 165.

GRAVEL WALK. The name applied to a path for which gravel forms the metalling. It is necessary (especially on a clay soil) to provide good drainage for the bottom as well as for the top of the path. The bottom is frequently made with a curved section, or by a reversed flat pointed arch, and the segment is sometimes improved by the addition of a notch in the centre to carry off the water that will ooze from the sides of the bottom, or sink through the gravel. Gardeners believe that the water will run off without the notch if the path lead up a slope. As the success of the formation of a path depends on its dryness, it is best to lay regular drains in the centre of the bottom if the path lead up a slope; or on the upper side if the path be made across a slope; indeed the path ought to have a drain on each side when made 4 ft. 6 ins. wide, which is the narrowest that can be allowed for two ladies walking side by side. Crossing drains are wanted for a sweep or a drive. It appears that in the southern counties the most ordinary way of commencing to make such a walk is by putting a layer of faggots as the immediate foundation for the gravel; but in the north the bottom is rammed if that operation be needed by the soil; the next steps are to spread a thin bed of lime (this is generally omitted), a layer of large stones, and another of small stones; and then to pass a heavy roller over the work in order to squeeze the whole together. Brickbats or well burnt clay (for which plaster rubbish is sometimes as wrongly substituted as the ill burnt clay used in the suburbs of London) are used where stones are not abundant: and if the materials have been properly heaped at the centre, the roller will easily form the roughly rounded base required for the gravel top. The thickness of the gravel depends upon its coarseness; if the pebbles be large, then 6 ins. will probably be required; if 4 ins. be intended, the stones should be less in size than a pigeon's egg: and no more than a sixth part of the gravel should be sand. It is held that pit-gravel binds better than river-gravel; and that it will become a compact body if moved directly from the pit to the walk, fully watered, and well rolled. When gardeners think that gravel has not enough earth in it to make it bind, they will recommend pulverized burnt clay, either mixed with the gravel before it is laid, or mixed with water and thrown over the laid gravel: but where the colour of the gravel is not an object, the easiest way to effect the combination is to grout it with thin lime. Brickdust mixed with Roman cement in equal quantities forms a composition that has been recommended for addition at the rate of 10 per cent. to sea-gravels containing entire or broken shells. Sand alone is sometimes used for the top dressing of paths, but should only be tolerated where from 3 to 6 ins. is to be used to supply the demand for a soft walk. In some cases 2 ins. of gravel are thought sufficient if the top be finished with fine gravel or sand; and the coarse gravel should be grouted. In redressing a path, the surface should be slightly disturbed before putting on the new gravel.

GRAVES (THOMAS), who probably succeeded L. Stockett,

was "sup'visor et c'licus" of the royal works 24 Elizabeth, 1581-2, receiving £45:12:6 as fees of office; *Burr. Mus. Add. MS.*, 18766, fol. 16 b. For the reception in 1581 of the commissioners of the French match, the queen caused a banqueting house, of a long square 332 ft. about, to be erected within the palace at Westminster by Thomas Grave, surveyor of the works, who served (*sic*) and gave order for the same: it occupied three weeks and three days to build in wood, being ended on 18 April, and cost £1744 19s. odd, and is described by HARRISON, *Chronicles*, fol., London, 1587, p. 1315. He was succeeded 1594 by R. Adams.

GRAVE STONE. This term is applied not only to a ledger or flat tomb stone, but to the head stone and foot stone, (frequently placed independently of any ledger or other horizontal stone,) and, by lawyers, to a mural monument, or even to a wooden memorial. In churches and churchyards such a memorial can legally be moved only by the ordinary, and not even by him if placed by virtue of a *FACULTY*. If it be set up without his consent, though by the permission of the incumbent, the former can call upon its owner to show cause why it should not be removed. But, by custom, the consent of the incumbent, especially if any fee be paid, is generally thought sufficient; and, indeed, in common practice a notice to the sexton, that he will be required to assist in fixing a memorial, is often the only mode in which permission is asked or obtained: that once fixed, however, the removal is a matter of difficulty, as is shown in the article entitled "The Uttoxeter Tombstone Case" in the *ECCLESIOLOGIST Journal*, 1852, xiii, 313-18, in which several of the cases are cited that are amongst others noticed in PHILLIMORE'S *BURN, Ecclesiastical Law*, 8vo., London, 1842, s. v. Burial; and in ROGERS, *Practical Arrangement*, 8vo., London, 1849, s. v. Faculty: those works, however, do not enter into the question of the property in a grave stone placed in the consecrated or unconsecrated portions of the recently established cemeteries. **STELE; MEMORIAL SLAB.**

GRAVINA (anciently Plera). A city in the province of Bari in Italy. It is surrounded with walls and towers, and contains a mediæval castle. The poorer classes live in grottos excavated in the tufa rock. Besides an old and large cathedral dedicated to the Virgin, with its two fine chapels, S. Sacramento 1614-23, and Sta. Maria Consolatrice 1630-45, the principal buildings are four parish churches; a monastery; three nunneries; the episcopal palaces erected 1645-84 (one joined to the cathedral, another in the villa Salamandria, and a third, near the suburban church of Sta. Maria delle Grazie built 1602); and the seminary, rebuilt 1690-1700, when the cathedral was restored. 96.

GRAVITY. The force which acts to produce gravitation, or the tendency of bodies, when left to themselves, to fall towards the centre of the earth. Gravity is, in fact, the cause of which gravitation is the effect, and in common language it is said to be produced by the weight of the body under consideration. The weight of a body is the resultant, or the sum, of all the equal forces of gravity which act upon each of its molecules; and the centre of gravity is called the centre of the parallel forces due to the weight applied to all the molecules of the body considered; it is a point such that if it be supported the body will remain in equilibrium in whatsoever position it may be placed whilst turning upon that point. Archimedes has the credit of having been the first philosopher who considered the subject of the centre of gravity, and he ascertained its position in a great variety of solids. The works of VINCE and PLAYFAIR contain much matter upon this subject. The general laws of gravity may be thus stated. 1. Bodies act upon or attract other bodies in the compound ratio of their masses; 2. The attraction varies in the inverse ratio of the squares of the distances of the bodies; 3. A sphere composed of homogeneous concentric rings attracts as though the whole of its mass were situated at its centre.

The *accelerating force of gravity* is a term frequently

used in philosophical disquisitions: it means the velocity which a body, if abandoned to itself, would acquire at the end of the first second of its fall; it is usually represented by *g*; and the value of it is usually given as being in London $g = 32.166$ ft.

Specific gravity is the ratio of the weights of given substances to some common measure, which is founded upon the principle that the masses of bodies are proportional to their weights. The usual method is to weight the bodies immersed in a fluid, and in vacuo; then, knowing the specific gravity of the fluid, the specific gravity of the solid is obtained by a simple rule of three sum: thus, let *w* = the weight lost by the body when immersed in the fluid; *w* = the total weight in vacuo; *s* = the specific gravity of the fluid; then *s*, the specific gravity of the body, is ascertained by the proportion $w : w :: s : s$. Water is the standard adopted for solid bodies and for liquids; atmospheric air for gases and aeriform fluids.

The following table of specific gravities of various articles will be found useful to the architect; water taken at 60° = 1.000, and weighing about 62½ lbs. per cubic foot.

| METALS. | | | |
|-----------------------------|-------|----------------|---------------------------------------|
| Lead, cast | - - - | 11.352 | Gun metal - - - 8.784 |
| Bismuth - - - | - - - | 9.822 | Steel, hard - - - 7.816 |
| Copper, cast - - - | - - - | 8.850 | " soft - - - 7.853 |
| " rolled - - - | - - - | 8.950 | Iron, wrought - - - 7.788 |
| " sheet - - - | - - - | 8.915 | " cast - - - 7.207 |
| Brass, cast - - - | - - - | 8.395 | Tin, cast - - - 7.291 |
| " wire - - - | - - - | 8.514 | Zinc, cast - - - 7.100 |
| MINERALS. | | | |
| Glass, flint - - - | - - - | 3.329 | Lapis Obsidianus - - - 2.348 |
| " white - - - | - - - | 2.892 | Selenite - - - 2.322 |
| " bottle - - - | - - - | 2.732 | Grindstone - - - 2.142 |
| " green - - - | - - - | 2.642 | Salt - - - 2.130 |
| Fluor - - - | - - - | 3.191 | Sulphur, native - - - 2.033 |
| Serpentine - - - | - - - | 2.958 | Nitre - - - 2.000 |
| Mica - - - | - - - | 2.900 | Brick - - - 1.557 to 2.168 |
| Basalt, Giant's Causeway - | - - - | 2.864 | Brickwork in cement - - - 1.640 |
| Marble, white Parian - - - | - - - | 2.837 | " in mortar - - - 1.768 |
| " green - - - | - - - | 2.741 | Blue Lias stone - - - 2.467 |
| " red - - - | - - - | 2.725 | Alum - - - 1.720 |
| " white Carrara - - - | - - - | 2.716 | Asphaltum - - - 1.400 |
| Porphyry - - - | - - - | 2.765 | Clay, common - - - 2.000 |
| Alabaster, white, antique - | - - - | 2.730 | " Medway - - - 1.440 |
| Calcareous spar, rhombic - | - - - | 2.715 | Chalk - - - 2.315 |
| " pyramidal - - - | - - - | 2.714 | Gravel - - - 1.900 |
| Slate - - - | - - - | 2.671 | Sand - - - 1.620 |
| Pitch stone - - - | - - - | 2.669 | Mortar - - - 1.715 |
| Granite - - - | - - - | 2.654 | Shingle - - - 1.424 |
| Rock crystal - - - | - - - | 2.653 | Slate, Welsh and Valencia - 2.888 |
| Amorphous quartz - - - | - - - | 2.647 | " Westmoreland - - - 2.791 |
| Purbeck - - - | - - - | 2.601 | Tile - - - 1.815 |
| Flint, white - - - | - - - | 2.594 | Coal, Scottish - - - 1.300 |
| " blackish - - - | - - - | 2.581 | " Newcastle - - - 1.270 |
| Portland stone - - - | - - - | 2.145 to 2.570 | " Staffordshire - - - 1.240 |
| Mill stone - - - | - - - | 2.483 | " Cannel - - - 1.238 |
| Paving stone - - - | - - - | 2.415 | Ice, probably - - - .930 |
| Touchstone - - - | - - - | 2.415 | Pumice stone - - - .914 |
| Porcelain, Chinese - - - | - - - | 2.384 | White lead - - - 3.160 |
| WOODS. | | | |
| Alder - - - | - - - | .800 | Oak (.970) English, just felled 1.113 |
| Ash - - - | - - - | .767 | " " seasoned - - - .743 |
| Beech - - - | - - - | .777 | " Bog, Ireland - - - 1.016 |
| Birch - - - | - - - | .793 | " Canadian - - - .872 |
| Box - - - | - - - | .960 | " Riga - - - .972 |
| Ebony - - - | - - - | 1.250 | " Danzig - - - .756 |
| Chesnut - - - | - - - | .610 | " American - - - .672 |
| Cork - - - | - - - | .240 | " African - - - .944, .972 |
| Elm - - - | - - - | .580 | Green heart - - - 1.000 |
| Larch - - - | - - - | .522 | Pine, pitch - - - .660 |
| Lance - - - | - - - | 1.022 | " red - - - .657 |
| Lignum vitæ - - - | - - - | 1.220 | " American yellow .461 to .529 |
| Mahogany, Spanish - - - | - - - | .800 | Fir, New England - - - .553 |
| " Honduras - - - | - - - | .560 | " Riga - - - .753 |
| " Some authors make it | - - - | | " Memel - - - .546 |
| range between - - - | - - - | 1.063 and .637 | " Scotch - - - .696 |
| Yew - - - | - - - | .807 to .788 | Plane - - - .640 |
| Peartree, trunk - - - | - - - | .616 | Sycamore - - - .690 |
| Willow - - - | - - - | .585 | Teak - - - .657 |
| Juniper - - - | - - - | .536 | Walnut - - - .671 |
| Logwood - - - | - - - | .931 | Cedar - - - .509 |

| | | | | | |
|----------------------|---|-----|------------------------|---|-----|
| Poplar, white common | - | 383 | Christiania white deal | - | 590 |
| Olive wood | - | 937 | American white spruce | - | 551 |
| Poona | - | 640 | Yellow pine | - | 461 |

FLUIDS.

| | | | | | |
|---------------------|---|------|-------------|---|------|
| Alcohol, commercial | - | 837 | Water, rain | - | 1000 |
| Milk | - | 1032 | " sea | - | 1026 |
| Naptha | - | 708 | Tallow | - | 945 |
| Oil, olive | - | 995 | Tar | - | 1015 |
| " sperm | - | 872 | Vinegar | - | 1026 |
| " linseed | - | 940 | Ice | - | 940 |
| Turpentine | - | 870 | | | |

ELASTIC FLUIDS.

| | | | | | |
|---------------------------------|---|------|-------------------------------------|---|------|
| Barometer 30"; thermometer 52°. | | | | | |
| Atmospheric air | - | 1000 | Nitric acid | - | 1271 |
| Sulphurous acid gas | - | 2265 | Oxygen gas | - | 1103 |
| Carbonic acid gas | - | 1500 | Nitrogen gas | - | 985 |
| Nitrous oxide | - | 1527 | Steam | - | 623 |
| Nitrous acid gas | - | 1194 | Ammoniacal gas | - | 690 |
| Chlorine acid gas | - | 2500 | Hydrogen gas | - | 684 |
| Chlorine | - | 470 | Carburetted hydrogen (lighting) gas | - | 420 |

The above table is extracted from the works by CARR, MOSELEY, HODGRINSON, RENNIE, GENNIEYS, MORIN, CLAUDEL, DAGUIN, TEMPLETON, etc.; but care has been taken to give in nearly all cases the highest gravities named by the most esteemed authors.

G. R. B.

GRAY (MASTER JOHN), mason, on 4 May 1484, was "re-sauit by the aldermen, etc., of Aberdeen as master of work to the building of S. Nicholas—to do all care concerning the said work that accordis to a master of work, both in labouring of his own person, devysing, be seyng and ourseying of other masons and workmen that shall be under him, for all the days of his life, to the final completing and ending of the said work, at all his possibility and power, the best wise that he can."—To which he swore. The said aldermen, etc., to pay 'for his fe' 20 pounds and 5 merks (£23; 16; 8 Scots), to be paid quarterly; SPALDING CLUB, *Extracts from the Council Register of—Aberdeen*, 4to., Aberdeen, 1844, i, 41. The work thus noticed was the choir commenced 1477; on 16 July 1495 Richard Ancram was appointed mason with 20 merks. The roof was put on in 1495, and the contract for the stalls was taken 26 Dec. 1507 by J. Ferdour: it was completed in 1508.

GRAYWACKE, see GRAUWACKÉ.

GRE, Grees, Gryse, Gressys, Gresys, Greece, Greeces. The term used in the mediæval ages for a step or steps. "*Greece* or *steyre* (or *tredyl*) *gradus*"; PROMPT. PARV. "*Grese* (or *grece*) to go up at, or a stayre, degre"; PALSGRAVE. "Six *greces* to be before the high altare, with the *grece* called *gradus chori*"; Will of Henry VI, for Eton chapel; and 'steps called *gradus chori*' for King's College chapel; NICHOLS, *Royal Wills*, 4to., Lond., 1780, p. 297, 302. "The first *gryse* called a *slypp*, ben twey weyes. The second waye goin northward by a hygh *grese* called a *steyr* of xxxii *steppys*"; William WYRCSTER, *Itinerary*, 175-6. In Norfolk, stairs are still called *grissens*; PARKER, *Dom. Arch.*, 8vo., Lond., 1859, iii, 37. "1332. For six smaller stones for the *grez* of the tower, 15s."; "1365-6. For two stones called *gressos* bought to sharpen the mason's instruments, 12s."; BRAYLEY and BRITTON, *Westmr. Palace*, 8vo., 1837, 156, 188; who quote DU CANGE for *gressus* and *gressus* as signifying a flint or paving stone; in the record it is obviously used for the 'oilstone' used by workmen. The term has been employed later, as in the quotation "at Lydington there is a cross raised upon several *greices*", GENTLEMAN'S MAGAZINE, 1796, lxxvi, 187.

GREASE, see LUBRICATOR.

GREASES, GRESSES, see GRE.

GREAT BARRINGTON. A parish partly in Berkshire, and partly in Gloucestershire, four miles from Burford in Oxfordshire. It supplied a soft easily wrought stone, said to be "usually called Puffstone, prodigiously strong and lasting"; by SMITH, *Antiq. of Westm.*, 4to., London, 1807, 272. Stone from many quarries at and near Great Barrington and Burford were formerly much used, but it has not been ascertained

which particular quarry or quarries supplied that for the following buildings; the repairs to Westminster abbey church, under Sir C. Wren, 1713-20; in building Blenheim house in Oxfordshire, under Sir J. Vanbrugh, 1704-20; in the erection of Wadham college chapel, Oxford, 1612 (*BUILDER Journal*, viii, 375), supposed for the crests of the roof, etc.; and in the lower part of S. Mary Woolnoth church by Hawksmoor, 1716-19. "The principal quarries near Burford are the Taynton and the Windrush"; C. H. SMITH, in *Transactions of the Royal Inst. Brit. Architects*, 4to., London, 1842, i, pt. 2, 133.

GREAT BRICK, see BRICK (SIZE OF), p. 142.

GRECA (FELICE DELLA) about 1630 completed the palazzo, commenced by G. della Porta and continued by C. Maderno, of Agostino Chigi in the piazza Colonna at Rome, given in FERRERIO, *Palazzi*, fol., Rome, 1655, pl. 56.

GRECA (VINCENTO DELLA) was a pupil of G. B. Montano. FERRERIO, *Il Nuovo Splendore*, iii, pl. 14 and 18, shows the church and oratory dell' Angelo Custode (the façade by M. de' Rossi) and the front added 1623-44 to the church of SS. Domenico e Sisto at Monte Magnanopoli at Rome, by this architect.

111.

GRECO-ROMAN. This epithet, which appears to have been adopted, if not introduced by BECCOGA, *Sull' Architettura*, fol., Venice, 1817, has become usual for a combination of details peculiar to Greek art with the features of Roman and Modern Italian buildings. In England Soane, Papworth, Gandy, Holland, Cockerell, and Elmes; in France Percier and Fontaine, with their disciples; in Germany Chateaufort, Gaertner, Klenze, Schinkel, and Weinbrenner; may be cited as the architects who practised a style which gained so much favour as to be regarded as the style of the nineteenth century.

GRECO TURCHINECCHIO, or Tyrian marble, has a colour inclining to blue. The steps of the Scala Santa, at Rome, taken from Jerusalem, are made of this marble, according to the BUILDER *Journal*, x, 379.

GREECE, see GRE.

GREEK (JAN DE), born at Dordrecht 2 July 1784, received tuition in drawing by Schouman, and in architecture by his uncle Jacob van Dalen, a builder. As one among the most promising students, he was sent by Louis Napoleon, then king of Holland, to Paris and Rome. Returning after an absence of seven years, he was appointed supervisor of the buildings belonging to the maritime establishment at Rotterdam; and afterwards in the survey of the Dikes and Polders. In 1816 he planned the improvements and alterations of the royal residence Soestdyck; completed the works left unfinished at the palace (old court) at the Hague; and made important alterations in the palace of the prince of Orange, now H.M. king William II. During these works he was nominated professor at the Royal Military School at Delft. The last years of his life he spent at Amsterdam, where he was appointed director of the public buildings; he rebuilt, with Suys, the Lutheran church; and effected considerable alterations and improvements when converting the foundling house into a court of justice. He was a member of the Royal Institute of Arts and Sciences, and of the Royal Academy of Fine Arts. He died 2 December 1835. J. Cranez and J. Warnsinck were pupils. VAN EIJNDEN, *Schilderkunst*, 8vo., Haarlem, 1820, iii, 255.

24.

GREEK ARCHITECTURE. For about one hundred years, indeed even in the present day, this term has been used to express the architecture of the Greeks and, with some propriety as derived from it, that of the Romans so long as the orders were employed: but it is now generally restricted to the style seen in those stately edifices decorated with elegant ornament that, in Asia Minor, Greece, Sicily, and the south of Italy, exhibit a taste which recent writers consider to have arisen from a fusion of Egyptian and Assyrian fashions; the first being supposed to predominate in the Doric, the other in the Ionic, order.

Although the merits of Greek architecture have been the

subject of praise to numerous writers, and although its details have been the object of research to careful collectors, it is remarkable that no comprehensive explanation of either merits or details preceded or superseded the investigation attempted, without reference to construction, by PAPWORTH, *Essay* prefixed to his edition of CHAMBERS, *Treatise*, fol., Lond., 1826, and with reference to construction by GARBETT, *Principles*, 12mo., Lond., 1850, pp. 89-91 and 136-166. From these it may be collected that Greek architecture is distinguished not so much by peculiarities of details as by its possession of qualities which are to be found singly in other styles, but which might be expected to be found united as the final result of experience and reflection rather than as the earliest and most successful effort to combine beauty with grandeur in building. Amongst these peculiarities and qualities may be enumerated the preference given to largeness of design over size of materials and magnitude of mass; the unity of design, however picturesque the plan; the conformity of the shape, arrangement, and embellishment of the minor parts; the uniform character of the whole work, and the consequent dignity of small structures; the combination of horizontal chief masses with vertical minor masses; the undisturbed continuity of leading lines; the decided interruption of secondary lines; the effect of height obtained by a succession of lines that shorten as they approach the summit of the work; the employment of diagonal lines in the profiles, in the decoration, and in the shadows; the modification of the opposition of the vertical to the horizontal lines by diagonal lines of mouldings and shadows; the modification of the opposition of the dense shadows to the strong lights by reflected lights; the paucity of diagonal lines as mouldings, which involved the necessity to preserve as much middle-tint as possible on each moulding, and therefore to adopt a conic section for its profile; the necessity of sculpture where any is introduced; the attention given to optical illusions; the relation of the entablature to the thickness rather than to the height of the column; the magnitude and simplicity of the architrave; the trust reposed in contrast rather than in gradation as a means of beauty; the truthful character of the construction in reality and in appearance; the grandeur obtained by extreme solidity assisted by the evident absence of any thrust, by rectangular openings, and by bold projections; the absence of the arch and of curved forms except in subordinate portions; the dignity of the cornice as the uppermost, and of the basement as the lowest, member of the wall; the small shadow giving emphasis to each large one; the small decoration adding strength to leading lines where interrupting secondary lines; and the amount of mental labour bestowed upon ornament; not forgetting the brightness of tint and smoothness of surface which are considered as attributes by both these writers, who repudiate for pure Greek architecture the imputation of external POLYCHROMATIC DECORATION.

To the above may be added the essential character of its ornament, viz., flatness with relief and great sharpness of execution: the amount of throating and undercutting is very great, for the general mass either of filleted bands or of ornament is but slightly relieved in itself, and depends upon its edges for its effect, as in the case of the foliage, where the stem seems to have been more the object of study than the leafage, and the leaf itself is almost invariably given as if it had a tendency to be prickly, ACANTHUS; HONEY-SUCKLE; while conventionality is so deeply studied that it is only in the Asiatic examples that any considerable introduction of curves of contrary flexure for the leading lines of the stem is to be observed. The peculiarities which Greek art impressed upon the details of buildings are mentioned in appropriate articles, as BASE, CORINTHIAN, DORIC, FLUTE, IONIC, etc. With regard to the localities in which the chief remains exist, the books mentioned at the end of this notice will furnish an index to the majority of those that have been illustrated.

The first important constructions in Greece appear to have

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been the CYCLOPEAN or PELASGIC or POLYGONAL walling to the cities; and, though the early date given to the Gate of the Lions at Mycenæ be not accepted, most architects will agree with FERGUSON, *Ill. Handbook*, 8vo., London, 1855, i, 258, that such sculpture exhibits a purely Asiatic form of art. The discoveries of the Lycian tombs confirm the general correctness of the assertion that the classic entablature was an imitation of woodwork; and this author considers that the change from constructing with timber to building with stone occurred in the sixth century before the Christian era in Lycia and in Greece; but the subject of the PROTODORIC order has yet to be considered, although he asserts, i, 263, that the temple at Corinth was "most indubitably copied" from the celebrated frontispiece at Beni-hassan, as boldly as that the bull-capitals at Delos and the caryatid figures at the Erechtheum were due to Eastern influence. A glance at the remains of Assyrian art, dating so late as B.C. 650, is sufficient to show the close connection between them and the best productions of Greek ornament. It would appear that Assyrian art might as easily have travelled East as West; yet FERGUSON, i, 129, speaks of the history of Indian architecture as beginning "with a strong admixture of Grecian, or at least of Western art, as if the Indians were then first learning from foreigners an art they had not previously practised; but this extraneous element soon died out, and is not again to be traced, except perhaps in Cashmeer, where it seems to have long remained in force"; and i, 17, he more strongly urges that this Western art was Greek, when he says that the sculpture of the tope at Jamalgiri is so nearly Greek in character as to prove incontestably, that it must have been executed while the influence of the Græco-Bactrian kingdom, B.C. 323-134, was still strong in that quarter. It is by no means certain that the Achæan emigrants, who reached the Granicus B.C. 1008, the captives removed from Barce in Africa, and from Branchidæ in Ionia to Bactria by Darius I. and Xerxes I., the prisoners taken from the Roman and Byzantine armies during the contest that was superseded by the Mahometan successes only to become more exhaustive of the Greek forces, did not, more or less directly, furnish a large portion of the decoration shown in KITTO, *Illustrations*, fol., Calcutta, 1838. It would seem that while Greece, as represented at Byzantium, enriched the East by transferring to it the Roman dome (at least FERGUSON seems to date about 350, the dome at Serbistan), she was also exercising an influence in Western Europe, which has been acknowledged with regard to Moresque and Italian art, although not, as yet, sufficiently recognized in the Romanesque.

Although Greek architecture must have passed through several phases in the course of the thousand years during which it existed, no better attempt at classifying the periods of it has been made than that (which is undoubtedly open to many grave objections) by INWOOD, *Erechtheion*, fol., London, 1827; viz. 1. The advance from the timber construction to the use of the Doric column; 2. The invention of the Ionic order about B.C. 550, with the introduction of statues as pillars; 3. The perfection of that order and the invention of the Corinthian B.C. 490-480; 4. The disuse of the Ionic order externally, with the revival of the Doric, the introduction of caryatids, etc., and the use of three orders in the same building; 5. Co-extensive with the reign of Philip of Macedon, the erection of circular edifices, the use of the arch cut in a single stone, and the decline of the orders; 6. The perfection of the Corinthian order, the adoption of constructed archways except in sacred buildings, and the marked decline of the style. The Roman buildings in Egypt and Syria might have formed another division. The Byzantine edifices have been separated into classes of periods by SALZENBERG, *Die Altchristliche Baudenkmale*, fol., Berlin, 1854.

The revival of attention to Greek architecture was due, not perhaps so much to the drawings now in the Bibliothèque Impériale made 1674 by Carrey for the ambassador Nointel, or to some of the works mentioned S. v. PÆSTUM, as to SPON and WHELER,

Voyage, 8vo., Lyons, 1678, Lond., 1682, and POCOCKE, *Description of the East*, fol., Lond., 1745: but more notice of it was undoubtedly caused by DALTON, *Antiquities*, fol., London, 1751, and LE ROY, *Les Ruines*, fol., Paris, 1758 and 1770, the reply to the last named author by PIRANESI, *De Magnificentia*, fol., Rome, 1762, and the criticisms by STUART, REVETT, etc., *Antiquities*, fol., 1762, 1787, 1794, 1816, and 1830. The excitement thus caused was rendered a matter of fashionable interest by the SOCIETY OF DILETTANTI, *Ionian Antiquities*, fol., 1769, 1797, 1840; *Unedited Antiquities*, fol., 1817; *Principles*, fol., 1852; and by the ambassador CHOISEUL-GOUFFIER, *Voyage Pittoresque*, fol., Paris, 1782, 1809-20. A few architects resisted the immediately prevalent fashion of attempting to reconcile a thoroughly modern house with the new style, by putting against it pilasters or columns of a Grecian Doric or Ionic order: at the same time there arose an impression that every building which aspired to be truly Greek, must be denuded of ornament, and must be subject to the strictest laws of regularity. Yet any critic might have learnt from the Athenian ruins alone that the finest buildings in the most pure and intellectual style of architecture were not destitute of the highest amount of reasonable decoration; that they were not so grouped as to appear component parts of one design; and that they were not so placed as to have any symmetry of relation with each other. The manner in which modern artists have mingled their own peculiarities with their treatment of Greek art is mentioned s. v. ENGLISH, FRENCH, GERMAN, and GRECO-ROMAN ARCHITECTURE.

Besides the works already mentioned, reference may be made to WILKINS, *Magna Græcia*, fol., 1807; and *Prolusiones*, 4to., 1827: HOBHOUSE, *Journey*, 4to., 1813: CASSAS and BENCE, *Grandes Vues pitt. de la Grèce*, fol., Paris, 1813: DODWELL, *Classical Tour*, 4to., 1819; and *Views*, fol., 1821: STACKELBERG, *Der Apollo Tempel*, fol., Frankfurt, 1826; *La Grèce*, fol., Paris, 1834; and *Die Græber*, fol., Berlin, 1837: BLOUET, *Descr. de Morée*, fol., Paris, 1831-8: FELLOWES, *Journal*, 4to., 1839; *Account*, 4to., 1841; and *Travels and Researches*, 8vo., 1852: TEXIER, *Descr. de l'Asie Mineure*, fol., Paris, 1839: MUIR, *Journal*, 4to., 1842: FASO DI PIETRA SANTA (duca di Serradifalco), *Antichità della Sicilia*, fol., Palermo, 1842: PENNETHORNE, *Elements*, 8vo., 1844: MATCH, *Neues Darstellung*, 4to., Potsdam, 1845: HITTORFF, *Arch. Antique de la Sicile*, fol., Paris, 1825, in progress; and *Architecture polychrome*, fol., Paris, 1852: and COCKERELL, *Temples at Ægina and Bassæ*, fol., 1860.

Some useful notes are contained in the CIVIL ENGINEER *Journal*, vii, 240; xi, 150; and xiii, 289; 109, 177, 209, 242.

GREEK CHURCH. The earliest type of a Greek Christian church has been supposed to be a circular plan surmounted by a dome; the second to be basilican with a single nave. FERGUSSON, *Handbook*, 8vo., London, ii, 943-991, notices the existence of north and south chapels contiguous, though not attached, to a church at Pergamus, and of two such chapels attached to a church at Ancyra; these he regards as steps towards the adoption of the basilican plan ending at the east end in three apses. It may be conjectured that the addition of the dome was an early effort of the Byzantine artists, and that many churches were afterwards built without it; in fact, that there is as little foundation for any belief that a Greek church ought to be square on plan as for the popular impression that it should be a cross church with arms of equal length; an impression evidently fostered by HALLMANN, *History of Greco-Russian Ecclesiastical Architecture*, given in the *Transactions of the Royal Inst. of Brit. Architects*, 4to., London, 1842, i, pt. 2, 88, with illustrations. The features of a Greek cathedral have been enumerated in the *ECCLIOLOGIST Journal*, 1845, iv, 105, as consisting of a nave and apsidal choir, with apsidal aisles running at the west end to the porch (*narthex*), to which might have been added the existence in some cases of one narthex over another, and in others of a sort

of outer narthex, which is sometimes an arcade. From the central apse is seen the artophorium containing the consecrated wafers placed at the back of the piscina under the altar, which is covered by a baldachin and stands on the chord of the apse. The northern apse serves as the prothesis, and the southern (with a deacon's door near it) as the diaconicum or metatorium, also called scenophylacium. Then across the church extends a screen or iconostasis containing the Holy gates, forming the background of a platform terminated by steps (*solium*), which was formerly the place for the monks, but later for the inferior orders of the clergy. In the monastic churches nearly all the building is choir, though the stalls do not extend over more than a third of its length, and are returned so as to form the western or Beautiful gates; but in the secular churches there is no division at the west end of the stalls, and in small churches the part that seems to be the nave is really the portion (*gynæceum*) allotted to females, who would otherwise occupy the north aisle. Consequently in small churches the Beautiful gates open at once into the narthex, but in larger edifices the doors from the nave to the narthex are known as the Great or Silver gates. The font is usually placed on the south side of the door in the porch. COUCHAUD, *Choix d'églises Byzantines en Grèce*, fol., Paris, 1842; SALZENBERG, *Altchristliche Baudenkmale*, fol., Berlin, 1854; give a collection of such plans, which may be compared with that built 1127-53 at La Martorana, and illustrated in the *Saracenic, etc., Remains*, by GALLY KNIGHT, who, *Normans in Sicily*, 12mo., London, 1838, p. 179, gives a plan, elevation, and section of an ancient Greek chapel at the village of Malvagna, about six miles from Randazzo, as an illustration of one of the very few remnants of the lower Greek empire now to be found in Sicily. *Illustrations*, s. v. Church, plan; BASILICA.

GREEK CROSS, see CROSS.

GREEK MARBLE AND STONE. The white Megarian, the grey Eleusinian, the bluish Hymettian, the veined Carystian, the snowy Pentelican, and the creamy Parian were chiefly employed by the Athenians; the other states seem to have been content with their local quarries.

GREEK MASONRY. The description of the different sorts of walling used by the Greeks will be found under the heads of CYCLOPEAN MASONRY; DIAMICTON; DIATONOS; EMPLECTON; ISODOMUM; OPUS INCERTUM; PSEUDISODOMUM; and POLYGONAL MASONRY. No example has yet been discovered of OPUS RETICULATUM in Greek work, though it was very frequently used by the Romans. OPUS SIGNINUM was evidently not masonry, but a species of BETON or CONCRETE.

GREEN. The ancient pigments used for this colour seem to have been chrysocolla, probably carbonate of copper (malachite); chrysocolla lutea, perhaps clay impregnated with blue vitriol (sulphate of copper) rendered green by a yellow dye; and viride appianum, apparently a chalk or clay dyed, as all the ancient green pigments examined by DAVY proved to be combinations of copper; PHIL. TRANS., 4to., Lond., 1815.

The six best modern pigments of this colour are ultramarine with yellow, terre-verte, also called verdetto and Verona green, native green chrome, native green cobalt, emerald green, and mineral green. Other pigments, not so durable, are verdigris; verditer, or green bice; Scheele's, Schweinfurt, or Vienna green; true Brunswick green; mountain green; African green; French green; Saxon green; Persian green; patent green; marine green; Olympian green; and malachite; which, like emerald green and mineral green, are formed from copper: while false Brunswick, or chrome, green is chromate of lead with Prussian and other blues. This method of imitating the mixture of ultramarine with yellow has grown into a system, but the colour is not durable: as in the cases of Hooker's green and Varley's green, which are Prussian or Antwerp blue mixed with gamboge or with Dutch or Italian pink; of cobalt green, which is cobalt blue mixed with chrome yellow; and of Prussian green, which is Prussian blue mixed with a

yellow oxide of iron or with French berries. *BICE*. Sap, or bladder green is obtained from the berries of the blackthorn, or from the green leaves of woad, etc.; and an emerald, or Venetian, green is prepared from the berries of the coffee plant. Invisible green is an olive. A good sage green is produced by the addition of blue-black and yellow ochre to terre-verte. *PINCOT, Treatise*, 8vo., Lond., p. 13, notices that a light blue ground is best for verdigris. *ANSTED, Elem. Course*, 8vo., Lond., 1850, has given the following list of standards for the various hues, tints, and shades, thus named and described, viz:—

Verdigris, green much inclining to blue; Amazon stone.
 Calandine, green with blue and grey; Chlorite; Beryl (various).
 Mountain, green with much blue; Beryl, Topaz, Aqua marine.
 Leek, green with a little brown; Prase.
 Emerald, Beryl, Emerald, Malachite (various).
 Apple, light green with a little yellow; Chrysoprase.
 Grass, green diallage, Malachite, Uranite.
 Pistachio, green with yellow and a little brown; Olivine, Epidote.
 Asparagus, pale green with much yellow; Asparagus stone, Grossularite.
 Blackish, Serpentine, Augite (various).
 Olive, Garnet, Pitchstone, Olivine, Pharmacosiderite.
 Oil, pale green with very little yellow and brown; Blende, Beryl, Pitchstone.
 Siskin, light green very yellow; Uranite, Pyromorphite.

So early as 1845 attention had been drawn in Paris, by Dr. Blandet, to the injury done to workmen employed in the manufacture of paperhangings by the use of the green salts containing arsenic; but the matter seems to have dropped until it was revived by the *LANCET Journal* in passages cited in the *BUILDER Journal*, 1857, xv, 715, and it was pressed by Dr. TAYLOR in a letter published 6 January 1858, in the *Times*, which produced a warm discussion. The *BUILDER*, xvi, 83, mentioned that green copper colours containing arsenic are not allowed in Prussia to be sold as water or oil colours for internal work or for paperhangings; and, 564, cites the report of an examination of the matter made for the Commissioners of Inland Revenue by G. PHILLIPS, which shewed that an arsenious acid does not volatilize from the surface of a paperhanging made with emerald or Schweinfurt green, having 11·8 grains of arsenic in one foot superficial, except at temperatures too high for human endurance. This report is given at length in the *BUILDING NEWS, Journal*, 1859, v, 703, 918, which, 940, describes the process adopted by Guignet in the manufacture of a new green pigment, the hydrated oxide of chromium, a more brilliant colour than any of the chrome greens hitherto obtained. It is easily distinguishably from the common hydrated oxide, which is a bluish grey, and from the anhydrous oxide of chromium (chrome green), by the influence which heat exercises upon the last named. The further discussion of the subject seems to have resulted in the statements that there are several arsenical greens going by various names (such as Scheele's green); that they contain from 58 to 71 per cent. of arsenic; that one piece of paperhanging contained about 50 grains of arsenical green; that the arsenical pigment is but loosely applied to the material; that perhaps the sulphurous acid of gas, fixing itself in the paper and becoming sulphuric acid, destroyed the size and left the arsenical green as dust; and that the diffusion of such dust in the atmosphere of a room would account for the symptoms in several cases of illness. Dr. LETHEBY seems to have thought that the green of flock was generally inert; that the green of the ground was dangerous; and that 58 grains was the largest quantity of arsenic that he had found in one foot superficial of paperhangings. *Journal of SOCIETY OF ARTS*, 1861; *CIVIL ENGINEER Journal*, xxiv, 134; *BUILDER Journal*, xix, 670; xx, 104, 303, 336, 414, 467, 766; and on 121, 667, it is stated that a few drops of ammonia will change arsenical greens into deep blue colours. *Times Newspaper* for 4 Sept. 1863, p. 10.

GREEN, see BOWLING GREEN.

GREENAN, see GRIANAN.

GREEN EBONY, see EBONY and FRAXINUS.

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GREENHEART. A name given to several varieties of trees.

1. A native of Jamaica, Demerara, and the Brazils, much like cocoa wood, but the bark is of a redder tint. The wood when first cut is of a light green-brown and striped, but it changes to the colour of Lignum vitae wood. It is chiefly used for turnery, but its texture is coarse.
2. *Laurus Chloroxylon*, a native of Guiana, used largely in ship building, and weighing from 51 to 61 lbs. per cubic foot. It is also called the Sipiera tree in Guiana, and cogwood in Jamaica. 71.
3. *BANCONOFF, Guiana*, 4to., London, 1789, 68-9, describes two species, the black and the yellow, differing only in the colour of their bark and wood. There is also a purple heart wood, which is at first of a bright crimson colour, changing to purple; it is esteemed more valuable than the preceding. The black greenheart is described as a very hard, fine, close-grained, heavy wood of British Guiana. The timber, about a foot in diameter, is used for ship building, planks, etc., and is considered more durable than the common greenheart. 71.
4. *Nectandra Rodioni*. A very hard, heavy, fine, but not even grained wood of the river Demerara, British Guiana; the duramen is deep brown, but the recent layers are of a broad pale yellow colour, 12 ins. in diameter. It is very abundant, and the timber, squaring from 18 to 24 ins., can be procured from 60 to 70 ft. long. It is well adapted for the planking of vessels, house frames, wharves, bridges, and other purposes where great strength and durability are required. It is stated to be the best timber for resisting tensile and compressive strains, and is therefore well adapted for keelsons for ships, and beams. 71.

Greenheart is placed No. 6 in the list of first class woods at Lloyds. 71.

Greenheart timber is now generally had recourse to in places where a worm (*limnoria terebrans*) is destructive. It appears to have been first used by J. Hartley of Liverpool, who published in the *Minutes* of the Inst. of Civil Engineers in 1840 an account of its properties as ascertained at the Liverpool docks. Its cost is considerably greater than Memel or than most of the other timbers generally used. R. Stevenson made several experiments on the ravages of this worm at the Bell Rock Lighthouse in 1814, 21, 37, 43. He found that greenheart, beefwood and bullet tree were not attacked, while teak wood stood well, although it suffered at last. The two former were quite sound after thirteen years' exposure. *CIVIL ENGINEER Journal*, xx, 16.

Greenheart obtained from Demerara is of a close firm texture, and frequently of large dimensions; it is purchased by the Government for ship-building, and by several of the dock authorities, on account of its asserted resistance to the attacks of the boring worm, the *teredo navalis*; but it has been proved to be nearly as much exposed to the ravages of these creatures as any other wood; *BURNELL, On Building Woods*, in *Proceedings of Society of Arts*, etc., 8vo., 1859. It is very dense, its specific gravity being 1.000; it is very hard, and is considered to be superior, in its powers of resistance to a weight acting transversely, to oak in the proportions of 2700 to 1800, and to red pine as 2700 to 1340. G. R. B.

GREENHOUSE. This name originally meant an orangery or conservatory; it was next used for a dry stove with stands for the display of such delicate plants requiring much light as the pelargonium, fuchsia, and erica; but it is now applied to a place for rearing hardy plants until they are ready for removal to the conservatory. In this sense it is the Fr. *serre tempérée*; Ger. *temperirtes gewächshaus*; the CONSERVATORY is the Fr. *serre froide*; Ger. *kalttes gewächshaus*; and the HOTHOUSE is the Fr. *serre chaude*; Ger. *warmes gewächshaus*.

GREENING. The term given by plumbers to the act of rubbing any green vegetable upon lead where it is to be soldered; the juice preventing the solder from attaching itself to any part that is not scraped free from the juice to receive it. 4.

GREEN MAHOGANY, see CHLOROXYLON.

GREEN MARBLE. There being no marble at present known with uniformity of green tint as its characteristic, it will be sufficient to refer for notices of stones and marbles with more or less green colour prevalent in them to the articles

BASALT; BRECCIA; CAMPAN; CIPOLLINO; GRANITE; PORPHYRY; and SERPENTINE. Those chiefly in use at present are the campan vert, and the 'granit vert des Vosges', obtained from France; and the verde di Egitto from Genoa and Carrara; the verde di Voltri from a quarry near Genoa; and the verde di Mare, also called Polcevera or Suza marble, as the quarries are near those places. The quarries which supplied the green marble of Laconia, described by PAULUS SILENTIARIUS as employed in Sta. Sophia, are said to have been rediscovered on the northern coast of the island of Tinos by the German sculptor Siegel of Athens; *ATHENÆUM Journal*, 1853, p. 1596. The notes in the *BUILDER Journal*, 1846, iv, 477, 490, with regard to the attempt made about 1840 to introduce to the English market green marbles from Ireland, describe apparently two varieties which met with little favour. The introduction about 1815 of the Anglesey or Mona marble seems to have had no better success; and the green serpentines of England do not appear to be very highly appreciated.

GREENSAND. The generic name given to two members of the subcretaceous formations, which are known as the upper and lower greensands, and are separated by the interposition of the black argillaceous deposit termed the GAULT CLAY. They consist of beds of sand, sandstone, limestone, and clay, usually of a green colour due to the presence of considerable quantities of small crystals of chlorite (i.e. a green silicate of iron) scattered through their substance. Geologists state that the upper greensand consists of the Shanklin beds, with irregular concretions of limestone and chert sometimes disposed in courses oblique to the inclination of the strata; and that the lower group abounds much more in the limestone, the beds being closer together and more continuous. The Gatton and other descriptions of firestones are specimens of the first division; the Kentish rag of the second. CALVERLEY STONE; FIRESTONE; GATTON STONE; GODSTONE STONE; HASSOCK; KENTISH RAG; MAIDSTONE QUARRY.

The chief localities in which the greensand formation appears in England are around the Weald of Kent and of Sussex, from Hythe by Petersfield to Pevensey, and in a sinuous line from the Wash to Weymouth; the thickness being about 400 feet. It occurs largely in Switzerland, where the Rhone has forced a passage between the beds of limestone in the place known as "les Pertes du Rhone"; it is highly charged with bitumen in those places and in the neighbourhood of Bordeaux, so much so as in fact to be worked for the extraction of asphalt. The greensand is highly fossiliferous, and it abounds in nodules of phosphate of lime; it is a water bearing stratum, and the springs contained in it have been worked in Paris, Tours, Brighton, etc., for the purpose of artesian wells, which are all supplied by the water contained in the lower greensand. G. R. B.

GREES, and GREEZE, see GRE.

GREGAN (JOHN EDGAR), F.R.I.B.A., was born 18 Decr. 1813 at Dumfries. He was a pupil of Walter Newall; 2 Feb. 1836 went to Manchester; and eventually became assistant to T. W. Atkinson, on whose departure in 1840, Gregan commenced practice on his own account, and contributed largely to the architectural improvement of Manchester. He designed the churches of S. John, Longsight; Belmont, Emanuel, and Brightmet, at Bolton; that at Inskip; and that of S. John, at Miles Platting, 1855; the schools at Irlam-o'-th'-Heights, Withington, and Turton, 1855; the chapel of the Diocesan Training School at Chester, 1845; the Presbyterian churches, Coupland Street, Green Heys; and Mill Street, Ancoats; with schools to the latter; the Jews' School at Cheetham Hill; and workmen's houses for Lord Granville at Shelton Colliery, Cobridge; private houses at Whalley Range for Mr. Ree; for Mr. Long and for Mr. Hough at Alderley; at Victoria Park for Mr. J. M. Schwabe; at Menai Straits for Mr. Salis Schwabe; at Prestwich 1851 for Mr. McConnell; at Higher Broughton 1854 for Mr. Higgins; and at Pendleton for Mr. A. H.

Heywood; a parsonage at Macclesfield Forest for the Earl of Derby; warehouses, one (near the Infirmary) for R. Barbour, given in the *BUILDER Journal*, 1850, viii, 409-14, which cost £8000, and for Mr. Maclure, Bloom Street; Mr. Ashton, Portland Street; and Messrs. Reuss, Cross Street. He also designed the lodges to the public parks; the savings' banks at Bolton, and at Dumfries in Scotland. His best work is said to be the bank of Sir Benjamin Heywood, Bart., and Co., S. Ann's Square, given in the *BUILDER Journal*, 1849, vii, 18. The New Mechanics' Institute, David Street, 1855, has been carried out from his designs by his successor W. R. Corson.

He acted for many years as honorary secretary to the Royal Institution at Manchester; and greatly assisted in the success of the local School of Design. He died at York Place, Manchester, 29 April 1855, in the 42nd year of his age, but was buried in S. Michael's churchyard, Dumfries. *BUILDER Journal*, xvi, 99. W. R. C. 14.

GRELLIER (WILLIAM) F.R.I.B.A., born 24 May 1807, at Peckham, Surrey, was articulated 1823 to George Smith; in 1824 admitted a student of the Royal Academy; 1826 obtained the silver medal for a measured drawing of the façade of the East India House (afterwards presented to the Company); and 1829 the gold medal for a design for a British senate house. He became a member of the Architectural Society at its formation in 1831; contributed largely to its portfolio of measured drawings; acted as honorary secretary for four years, and was presented with a testimonial by the members on its junction with the Royal Institute of British Architects in 1842. In 1838 he obtained the second premium of £30 for a town hall and market place for S. John's, Newfoundland; *CIVIL ENGINEER Journal*, i, 174; and in 1839 the premium of £300 for a design (to be executed for £150,000) for the New Royal Exchange, London, from amongst eighty-eight competitors. In 1843-9 he designed and carried out, as honorary architect, the almshouses at Ball's Pond, Islington, for the Tilers' and Bricklayers' Company; the company consequently presented him with its freedom, elected him on to the court, and in 1849 master: he also prepared an estate-book of their property. He designed 1839 the Ethelburga Society Charity Schools, Wormwood Street, Bishopsgate; 1839 the Dry Meter Gas Works, New North Road; and 1846-8, at Liverpool, the Royal Exchange Insurance buildings (Italian), given in the *BUILDER Journal* 1848, vi, 619; the façade in North John Street is about 93 ft., and that in Dale Street 52 ft. 6 in. long, both being of stone; the cost was about £17,500; that of the land about £10,000. He was appointed November 1838 District Surveyor for Whitechapel. He died 7 January 1852, in his 44th year, and was buried in Norwood Cemetery. Memoir by Dr. H. C. Barlow (priv. print).

GRENIER (. . .) with Estone built 1454 a bridge over the Allier, at La Vieille Erioude, in the department of Haute Loire, in France; it was of one arch 183 ft. 9 in. span, 16 ft. wide, and about 60 ft. high, which failed in 1822. BRIOUDE.

GRENIER (LOUIS) born 1733 at Amiens, was a pupil of the Academy at Paris. He established himself in practice at Prague for ten years, but was invited 1774 (with the rank of Colonel of Engineers) to Salzburg, where he undertook the alterations in the winter palace, in Mirabell, at Heilbrunn, Klessheim, &c., and conducted the erection of the new archiepiscopal palace at Salzburg. He died 1811, in the 78th year of his age.

GRENOBLE (Lat. Cularo, afterwards Gratianopolis). The capital of the department of the Isère in France. The site of the old city is supposed to be occupied by the present quarter of S. Laurent or La Perrière, which consists of a long street, protected by the Bastille crowning the hill on the right bank of the river; another citadel, l'arsenale, defending the present city called Bonne, with its suburbs S. Joseph and Treclouitres. The rue de Bonne was chiefly built 1607-12 by rich persons;

EXPILLY, *Plaidoyez*, 4to., Paris, 1612, p. 650-663, gives a list of the structures then erected. The left bank is lined by quays formed about 1840, with mean old houses that communicate by a stone and a wire suspension bridge, with the modern city on the right bank, which contains some good places, and well-paved but narrow streets formed by houses of three or four stories with flat tiled roofs. The use of gas is general. The front, with a Romanesque porch (said to date 960) of stone is all that is visible externally of the brick cathedral dedicated to the Virgin, which, according to BOURASSÉ, *Cathedrales*, 8vo., Tours, 1843, with the exception of a side door belonging to the style flamboyant on the right of the building, is an edifice belonging chiefly to the end of the eleventh and the beginning of the twelfth century, although represented as rather later in the five plates which are given by NODIER and TAYLOR, *Voy. Pitt.* (Dauphiné), fol., Paris, 1845, who also, in addition to the very pure gothic tomb of Bishop Chissay (ob. 1407) and the rich tabernacle ascending to the vaulting, give several illustrations of the town, of the wooden bridge now superseded by that of wire, and of the remarkable places in the vicinity. The cathedral is three ailed, without transepts, and has a square belfry over the porch; it is entirely of Pointed work internally except as to the bay next to the entrance. The brick church of S. André was formerly the chapel of the palace of the Dauphin; it dates 1226-36, and is of a style of transition to Pointed art, except the spire, which belongs to the end of the thirteenth century, and an aisle dating in the fifteenth century; it is given in NODIER, who also illustrates the remarkable crypt of the church of S. Laurent, vaulted upon two ranges of pillars, those in the upper range in pairs over the single ones below. Three other churches and five nunneries are all that remain unconverted to lay purposes out of the twenty monastic establishments which formerly existed. The large and handsome episcopal palace attached to the cathedral is in a Pointed style; as is the *palais de justice*, except that the right side of the front was erected before 1461 or while Louis XI was dauphin, the centre 1602, and the left side in the seventeenth century; the rich ceiling of the great hall, which was executed at the expense of Louis XII (1498-1515), is given in NODIER. A few houses dating earlier than 1600; the hôtel de ville or palais de préfecture with its massive tower, formerly the hôtel de Lesdiguières; a Protestant church; four hospitals and two asylums; the theatre; and the university, with many educational establishments, and the abattoir, given *s. v. pl. 5*, are the other chief structures; but Grenoble is chiefly visited by architectural students for the sake of the Chartreuse, which is distant about ten miles. The buildings are chiefly made of a compact grey limestone from quarries at Fontanil and Sassenay, which is preferred for some reason to the similar stone that is procurable from large quarries just outside Grenoble on the road to Valence: BRARD, *Minéralogie*, 8vo., Paris, 1820, ii, 20; CHAMPOLLION-FIGEAC, *Antiquités*, 4to., 1807, and *Nouveaux Eclaircissements*, 8vo., 1814; PITOT, *Histoire*, 8vo., 1830; BONNEFOUS, *Notice sur Notre Dame*, 8vo., 1840. 50. 96.

GRES. The plural of GRE, a step; a word used by mediæval writers with great variety in the mode of spelling.

GREY. The following names for varieties of this colour, with the standards proposed, are given by ANSTED, *Elementary Course*, 8vo., London, 1850.

Ash grey, Epidote, Leucite.
 Bluish grey, Hornstone, varieties of Carbonate of Lime.
 Greenish grey, Cat's eye and other varieties of Quartz, Mica.
 Pearl grey, Horn silver, Quartz, Heavy Spar.
 Smoke grey, dark varieties of Flint.
 Yellowish grey, compact Limestone, Flint.

Grey has been noticed as capable of division into two classes, neutral, and semineutral. The first is black with white; the second black with blue, with olive, or with purple, etc.; and besides dull grey ultramarine ashes, ultramarine is used

with black and white. The pigments called neutral tint, Payne's grey, etc., are chiefly sepia with indigo or other blues, and madder or other lakes: but madder brown with blue makes a fine grey. White with blue-black and Venetian red makes a grey stone colour.

GREY FRIARS, or Mendicant Friars, see FRANCISCAN BUILDINGS.

GREY MARBLE (It. *bigio antico*). A beautiful grey marble of a bluish pearl tinge, anciently quarried in the isle of Lesbos.

GREY STOCK. A brick made of common earth and thoroughly burnt in a close clamp; it is so called to distinguish it from the *place* brick on the one hand, and the *red* stock or kiln burnt brick on the other. BRICK, manufacture of. A. A.

A "grey stock is a brick of the third quality of the best or marl brick"; STUART, *Dict.*, which is manifestly wrong.

GREY STONE. A term found in the records of mediæval buildings for a building stone; thus 1244, 28 Henry III, 100 barge loads of grey stone (*grisie pelvæ*) to be purchased by the sheriff of Kent for the king's new works at Westminster; WALPOLE, *Anecdotes*, Wornum's edit., 8vo., London, 1849, p. 8. It is presumed to have been procured at Maidstone in Kent, for the foundations of the old palace and of Westminster abbey, and to be rag stone; SMITH, *Antiq. o. Westm.*, 4to., London, 1807, 271.

GREY STONE LIME. The lime used in London under this name is obtained from the lower chalk formation, just at the zone where the chalk becomes so impregnated with the silicate of alumina as to assume the character of a marl. In fact, the stone quarried for the purpose of burning for this lime is called geologically 'chalk marl'. It occurs at the outcrop of the chalk formation, at Dorking, Mersham, Godstone, etc.; and at Cambridge and Isleham in the Midland counties: it yields a moderately hydraulic lime, and contains from 3 or 4 to about 8 or 12 per cent. of the silicate of alumina. The best varieties are heavy in the unburnt state, and about 0.86 of specific gravity when fresh burnt from the kiln; it rapidly absorbs moisture, and it fuses into a powder, of about two and a half or three times the bulk of the original material. The rate of slacking is rather slow, and great detriment is occasioned by the imperfect manner in which this operation is very often effected. G. R. B.

GREYWACKE, see GRAUWACKE.

GRIANON, or GREENAN, of Ailech. The name (properly Grian-an, the sun's place) of a mountain separated by a ford from the island of Inch, on the south side of Lough Swilly, four miles from Derry, in the county of Donegal. It is remarkable for the remains of a circular temple (or rather fort, as it is termed by the writer, supposed to be PETRIE, of the Ordnance survey of the parish of Templemore, p. 250) 82 ft. in internal diameter, with walls from 12 to 16 ft. thick, containing passages, all enclosed by a ditch at 60 ft. distance, with another ditch as far from the outer one. A plan showing something like a raised passage to a central platform is given in the DUBLIN PENNY JOURNAL, 4to., 1834-5, iii, p. 349, which remarks that it is the only monument of its kind in Ireland; but the writer seems to have forgotten the Staig Fort near Kenmare.

GRID appears to be used in some places for a stench trap with a grated top.

GRIDIRON, see GRATE.

GRIFFIN (Gr. *γρίψ*; Lat. *gryphus*; It. *griffone*; Fr. *griffon*, from Gr. *γρυπός*, 'crooked', on account of its curved beak). A fabulous monster often mentioned by ancient writers, and much used as a decoration in architecture. The griffin of the Hebrews is supposed to have been the *ossi-fraga*, or sea eagle. Fond as they were of monsters, particularly the sphinx, the Egyptians do not seem to have sculptured the one in question. The legend that griffins inhabited the north of Scythia, and employed themselves in guarding quantities of gold against the incursions of a one-eyed race called the Arimaspians, is to be found in HERODOTUS, *Thalia*, 116,

Melpomene, 13; he cites Aristeas as his authority, who is said to have flourished 560 years before the Christian era. PLINY, *H. N.*, vii, 2, may also be consulted. It is usually delineated as a species of lion or leopard with the head and beak of an eagle, a sort of pointed crest on the back of the neck like the comb of a cock, sometimes with short horns, and always with a large pair of wings. Sometimes, instead of that of an eagle, it has the head of a lion or a leopard with horns or such a crest as has been described before. In this case, it is more properly a winged leopard, or ptero-pard. The plate (*Illustrations*, s. v.) shows a variety of these monsters, the oldest of which are probably Nos. 1, 4, and 9, from Branchidae and Eleusis. No. 2 bears a torch, probably hymenæal; No. 7 is a Bacchic pard drinking wine from a *cylix*, into which it is poured out from a *prochous* by a Bacchante. It has been supposed that the ancients did not believe in the existence of such an animal, but merely used it as an emblem of great strength combined with swiftness.

A. A.

The SOCIETY OF DILETTANTI, *Ionian Antiquities*, fol., London, 1769, i, p. 51-2, chap. 3, pl. 8-9, remarks with regard to the griffins on the capitals of the antæ and in the frieze between the capitals of the antæ in the cella of the temple of Apollo Didymæus, that the griffin is usually composed of the head and wings of an eagle, with the body, legs, and tail of a lion; that in this frieze it has the head of a lion with the horns and beard of a goat; that the monster, being sacred to Apollo in particular, has a lion's head, because Sol is most powerful in the sign Leo; that the goat's horns and beard may have been adopted from the goat of metal offered at Delphi by the Cleoneans; and that the monster is introduced as guarding the lyre, which was also an attribute of Apollo. BROWNE, *Pseudodoxia*, iii, 11, considers that the griffin well displays hieroglyphically the properties of a guardian: the ears, implying attention; the wings, celerity of execution; the lion-like shape, courage and audacity; the hooked bill, reserve and tenacity: it is also, as compounded of the lion and the eagle, an emblem of valour and magnanimity. The wings are not mentioned by HERODOTUS; but PLINY, l. c., says the griffin is "*ferarum volucrum genere*". A very copious dissertation upon the topics mentioned above is given in CLARAC, *Desc. du Musée du Louvre*, 8vo., Paris, 1826-53, ii, 278-86, and reference should be made to the bassi-relievi, pl. 193-5, 255.

An idea, in the *Annales des Sciences Naturelles*, 1829, xviii, 54-6, by ROULIN, that the griffin was derived from the tapir of Malacca and Sumatra, is supported by him on the grounds that the beast in its usual sitting posture is not unlike the conventional griffin; that its nose, bearing some resemblance to the bill of an eagle, might have caused the introduction of the bird's head, as well as the addition of its wings; that the division of the foot of the tapir might have caused the adoption of the lower part of the lion; and that the hogged mane of the tapir is retained to some extent in the repetition of the dorsal fin. But those islands were unknown to the ancients.

* *

In mediæval architecture the griffin is often used as a grotesque ornament, particularly as a GARGOYLE (and *Illustrations*, s. v.). The heralds of the period, however, represent it not as before described, but as half eagle and half lion. With a series of points down the back, like the fin of a perch, and a barbed tail, it becomes the mediæval dragon. With two legs only, it is a wyvern; and with the head of a cock, a cockatrice. If the tail ends with the head of a dragon, it is a basilisk. A. A.

GRIGO (GIOVANNI BATTISTA) continued the old church of Sta. Maria di Consolazione, designed by P. F. Cortone 1637; and seems to have been the same person as G. B. Ghio, Ghisi, or Ghisio, who with A. Corradi, G. Gandolfo, and A. Torriglia, designed 1655 the Albergo de' Poveri at Genoa. He died 1656. GHISI.

GRIGO (SIMONE CANTONE), to whom the conservatorio Fieschi at Genoa is attributed by NAGLER, *Lexicon*, seems to

be the CANTONE (Simone) to whom TIPALDO, *Diz.*, vii, 22, does not attribute that building, which is said to have been designed by Gaetano Cantone in ALIZERI, *Guida*, 12mo., Genoa, 1847, ii, 923.

GRILIANO (MAFFIOLO DE) appears under the date 14 September 1399 in the list of architects employed on the cathedral at Milan.

27.

GRILLAGE and GRILLE, see GRATE.

GRILLON (EDME JEAN LOUIS), born 7 February 1786 at Paris, was a pupil of Labarre, and afterwards of Debret and Lebas; received six medals in the academy before 1809, when he obtained the second prize for his design for a cathedral; studied for two years in Italy; became 1811 sous-inspecteur at the abattoir du Roule; 1820 inspecteur at the palais des Beaux Arts, and the salle provisoire de l'opéra; 1819 rapporteur to the Conseil des Bâtimens Civils; and 1832 its inspecteur-général, until his death 23 August 1854 at Dieppe. He was a member of the Comité Historique, and occupied a seat in the conseil municipal et général de la Seine. As one of the government architects, he was chosen to direct the works of the pedestal for the statue of Louis XVI, intended to have been put in the place de la Concorde. Besides the restorations of several châteaux dating from various periods, he designed several large edifices, amongst which NORMAND, *Paris Moderne*, 4to., Paris, 1837, i, pl. 59-61, gives 'quatre hôtels réunis dominant rue S. Dominique et rue Las Cases, 1831'; and GOUR-LIER, *Choix d'édifices*, fol., Paris, 1825-50, shows pl. 189-91, the entrepôts des Douanes in the place de Marais, 1833-4; and pl. 271, 276-7, the entrepôt des sels 1840, and the entrepôt d'octroi 1839, in which last matters Leon and Greterin were partners with Grillon, who was one of the editors of the *Choix*. He also published, with Callou and Jacoubet, *Etudes sur un nouveau système d'alignement et de percement de voies publiques*, 8vo., Paris, 1848.

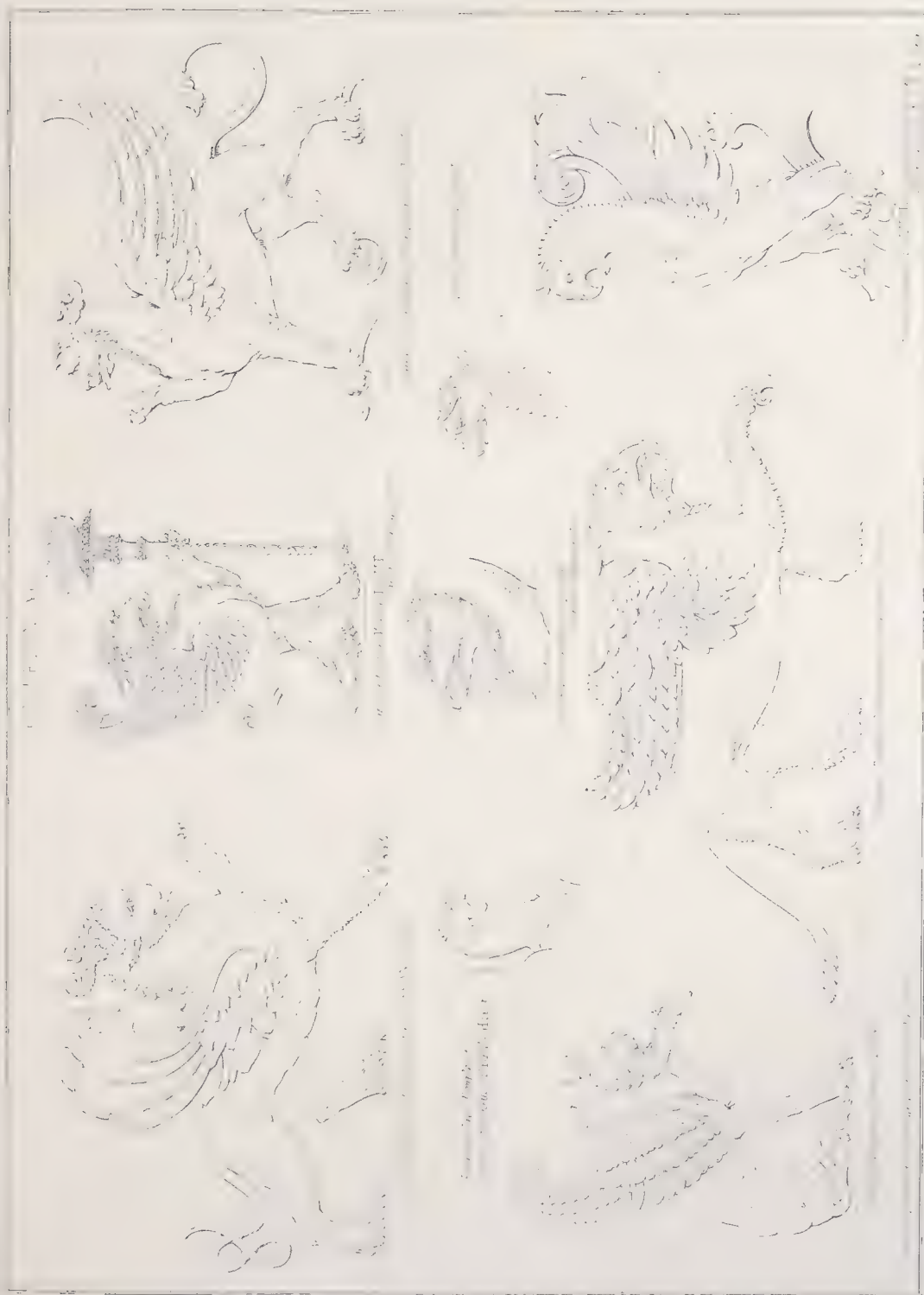
68. 112.

GRIMALDI (IL PADRE DON FRANCISCO), born at Oppido, became a Theatine monk, and was much employed at Naples, where, according to MILIZIA, his first work was the house of his order, called SS. Apostoli, erected 1590. In that year he was certainly commissioned to bring into its present state the church of S. Paolo, and 1600 the church of Sta. Maria degli Angeli at Pizzofalcone, both belonging to his order. He obtained in competition 22 May 1608 the commission to erect the chapel (called the tesoro di S. Gennaro), attached to the cathedral, which was finished 1670; this work has been attributed to F. Negro. The church of the Augustinian nunnery of S. Andrea Apostolo, 1578, and the church of the Dominican nunnery of Sta. Maria della Sapienza, 1607, were also the work of Grimaldi, and in 1620 he designed the church of the Franciscan nunnery of SS. Trinità alla Monte di S. Martino, modernized with a new façade by Fansaga. The first stone of the church of SS. Apostoli, belonging to the Theatines, was laid 4 November 1626, and the fabric as designed by him was consecrated 10 October 1648. MILIZIA notices that the church of S. Andrea della Valle at Rome (1586) is also attributed to this architect.

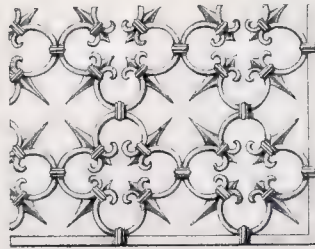
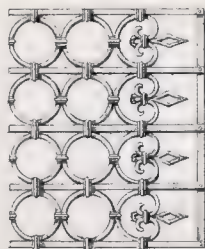
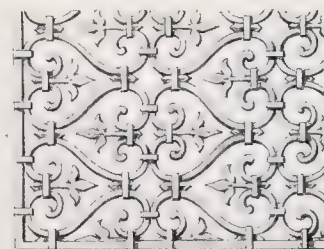
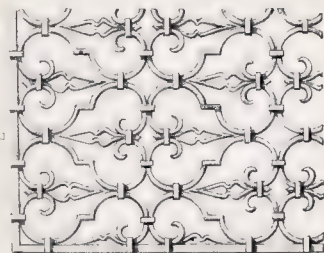
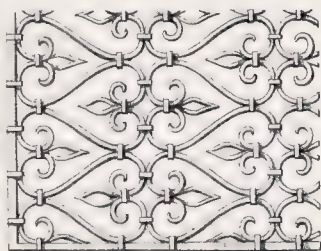
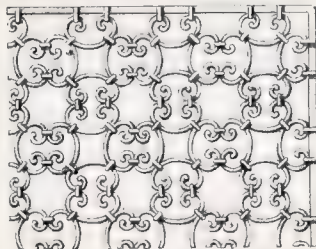
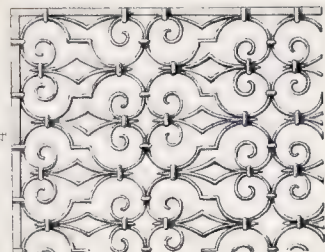
8. 95.

GRIMBOLD, see GRUMBOLD (ROBERT).

GRIOFFE, MARBLE (Fr. *marbre de griotte*, formerly written *griotte*). The general name for marble having oval blood-red spots of black nautilus shells imbedded in a dark brown ground due to the transitional limestone formation. No doubt the name is derived from the cherry colour, but it is remarkable that BLONDEL, *Cours*, 8vo., Paris, 1771, v, 103, says that the spots are cherry-red on a deep flesh coloured ground; recent Dictionaries assert that the Fr. word *griotte* means the black cherry, and that the name alludes to red and brown spots. The griotte furnished by the quarries in the valley of Campan above Bagnères de Bigorre, in the Pyrenees, has a ground of a blood-red colour: and a fine griotte is supplied to the southern towns in France from quarries at Caunes, twelve miles north-east of Carcassonne. This is frequently





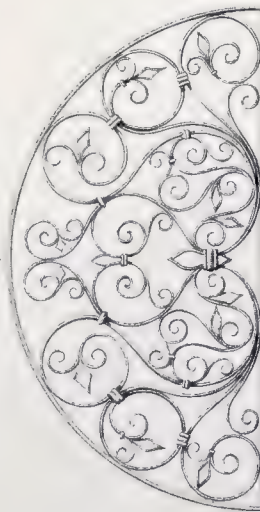
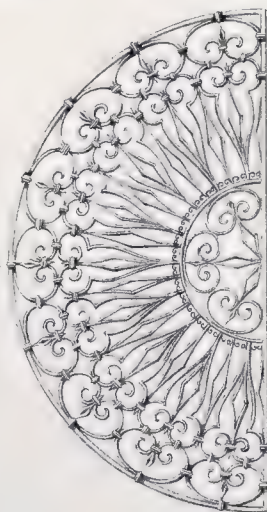
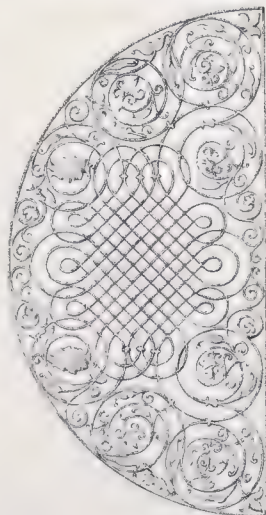
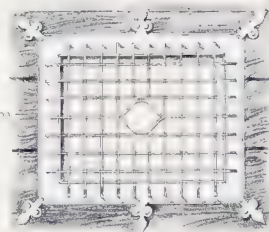
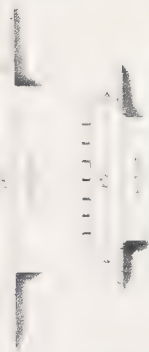
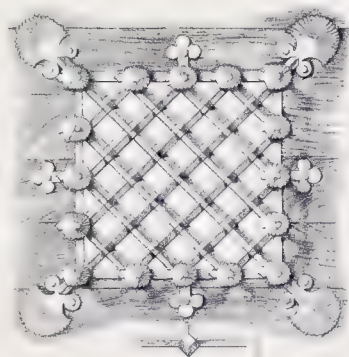
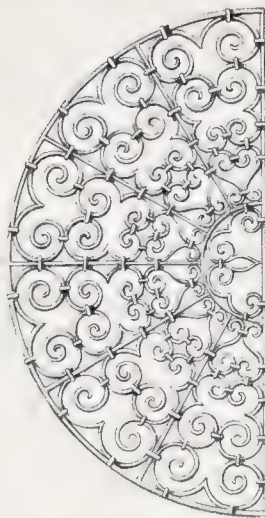
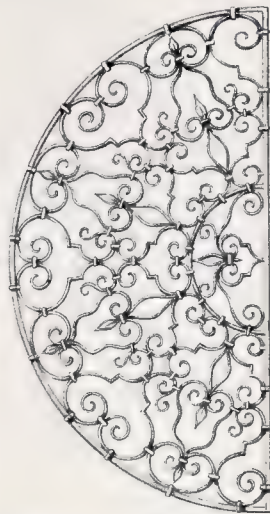


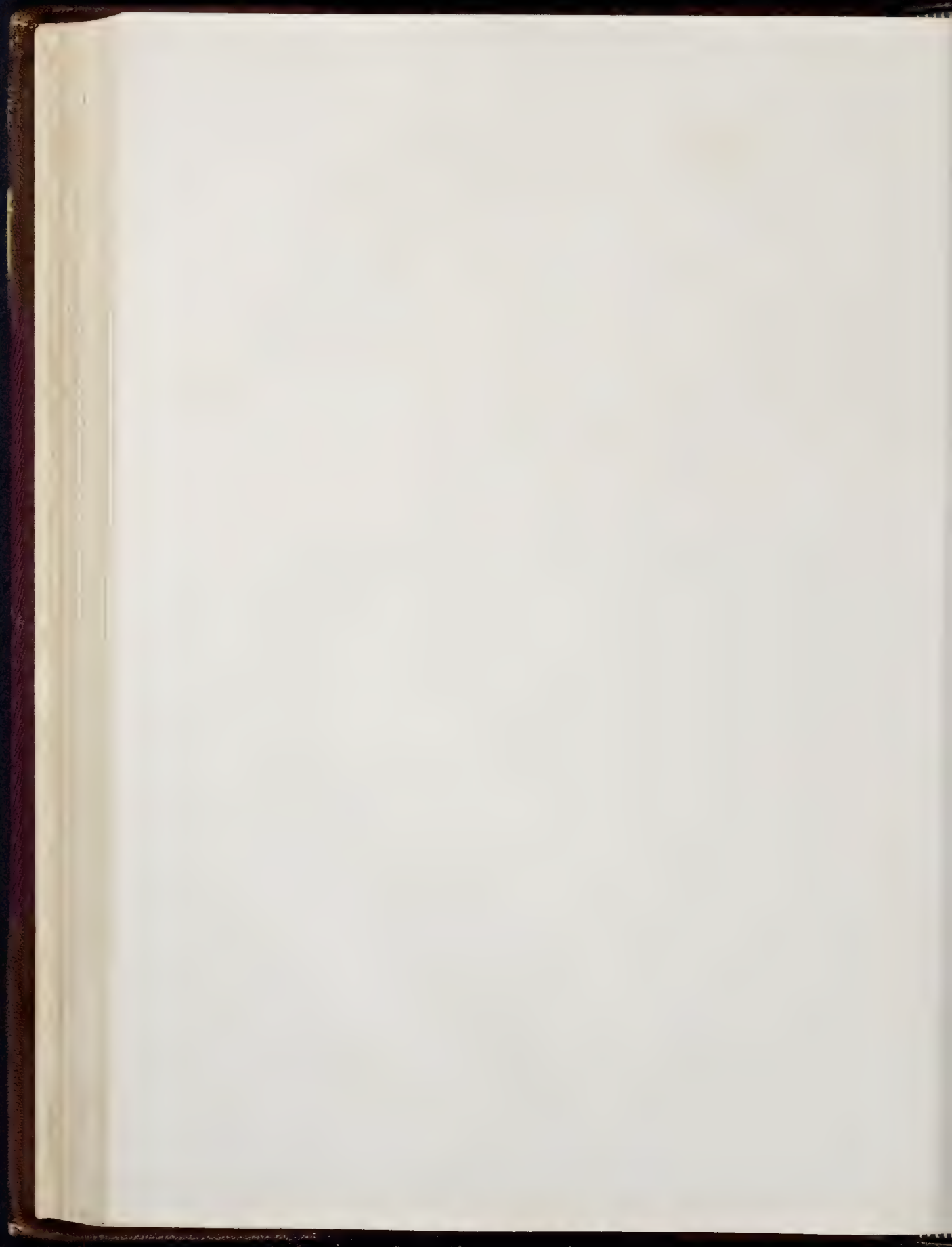


GRILLE



Fig. 1. 1/2













called Italian griotte when it is without the usual transverse large white veins. Some specimens resemble rosso antico, and have no white veins. Another griotte has green veins.

GRISAILLE. This French word, adopted by English writers, originally expressed that variety of CAMAIEU work which was a monochrome executed with grey (Fr. *gris*) tints; thus French writers consider *sgraffito* as a species of grisaille: but for several years the word has in England been almost exclusively used with reference to painted glass. 25.

In speaking of glass, therefore, this term would properly be applied only to white glass with figures or patterns expressed by means of a brown or greyish enamel, but it also comprises those windows where small pieces or strips of colour in addition are used to heighten the effect. For ordinary purposes glass windows may be divided into three heads. 1. Where white glass alone is used, the pattern being obtained by the intricacy of the glazing; 2. Where coloured glass forms by far the greater portion of the composition; and 3. Where very little colour is used, the pattern being expressed partly by the leading, and partly by figures and patterns executed with a brown enamel (this is the grisaille). Very often all these three varieties were to be found in the same building. Thus in Salisbury cathedral, the only one in England which was carried out and finished with anything like expedition, the clearstory lights were glazed as No. 1 (even here there was a little colour, but nothing to speak of); the eastern and western windows were in all probability full coloured, like No. 2; while No. 3 was applied to the rest of the church.

It is needless to say that grisaille windows, like everything else in the middle ages, were continually changing with the progressive rise and decline of art. Thus one of the earliest figured in the *Hints on Glass Painting*, consists of a ground of diamond quarries, each of which has a conventional Early English piece of foliage on a crosshatched ground. Little pieces of coloured glass are introduced in the lower parts of these quarries, the whole being surrounded by a coloured border. But the usual way in which Early English grisaille windows were composed will be best seen in the Salisbury volume, where there is an engraving showing how all the complicated patterns in the glass of that cathedral may be resolved into a series of square, circular, quatrefoil, or lozenge, and indeed of any other shaped forms, laid upon each other in a regular manner; each form has its coloured eye and often its coloured border, the intermediate space being filled up with conventional foliage upon a crosshatched ground. In the glass of the chapter house the same arrangement was carried out, but the crosshatched ground was omitted. In every case a richly coloured border was carried round the sides, and frequently round the bottom of the window or window light, as the case might be. Coloured medallions were also introduced often in the lobes of the tracery, and sometimes one or more rows of highly coloured subjects or coats of arms run quite across the window.

The next change took place about the beginning of the fourteenth century, when the borders, medallions, etc., were placed in very much the same positions as in the preceding century, the difference being that the foliage ceased to be conventional, and became natural; but the great change took place in the ground. The system of a series of overlapping forms disappeared, and was superseded by a series of geometrical outlines usually represented by bands of colour which interlaced with each other; the ground proper being simply ornamented with natural foliage, which takes its own course totally irrespective of the coloured interlacings supposed to be superposed. The glass at Merton college, Oxford, is of this description, except that there is no colour in the interlacings, the want of it being made up by the occasional insertion of small medallion heads, etc. In Cologne cathedral these thin coloured lines take the form of a series of geometrical forms, such as cusped spherical triangles, etc., touching each other and running over the whole surface, thus forming a minute diaper of tracery.

ARCH. PUB. SOC.

In the Perpendicular period, the artists who worked in glass, when they had to use grisaille alone, generally went back to the quarry, with some simple ornament in it stained with the yellow stain, which WINSTON states began to be used in the beginning of the fourteenth century; an arrangement occasionally varied by substituting diagonal inscriptions, which took the place of a certain number of quarries. This sort of grisaille was very often employed in windows of halls, and for other domestic purposes, when it was further broken up by the introduction of coats of arms, as at Ockwells, Berkshire (LYSONS, *Mag. Brit.*), or with roundels with grisaille subjects enclosed in coloured borders. A most excellent example of Late Decorated grisaille quarry glass from the west window at York minster, is given in WEALE, *Quarterly Papers on Architecture*, 4to., London, 1843, i.

Towards the end of the fourteenth century figure glass in grisaille appears, of which LASTEYRIE copied a charming specimen from the cathedral at Chartres. The figures in the original are not very large; and they are applied in a row upon a diapered background; the only colour used being the yellow stain. Many of the Late Decorated and Perpendicular windows contain so much white glass, both in the figures and in the canopies, that they certainly come under the head of grisaille. Of this kind, LASTEYRIE gives examples where the colour is confined to the background of the canopy, and to the vaulting and background of the niche. Of course in effect there would be very little more colour than is seen in the Salisbury grisaille; only it is more massed together. The Renaissance artists went still further, and very frequently the only colour is a little blue in the background; some beautiful glass of this description is placed in the museum at Rouen. At the church of S. Eustace at Paris (LASTEYRIE) this system is inverted; the figures are coloured, but all the rest of the window is composed of great masses of architecture elaborately shaded. The great use of grisaille glass was for domestic purposes; and in some parts of Flanders and Germany there must have been regular manufacturers of those little roundels, representing subjects of devotion, which are even now so often to be met with in the curiosity shops of Europe. ROUNDELL.

WINSTON, *Hints on Glass Painting*, 8vo., Oxford, 1847; LASTEYRIE, *Histoire de la peinture sur Verre*, fol., Paris, 1843; MARTIN and CAHIER, *Les vitraux de Bourges*, fol., Paris, 1844; give examples of grisaille windows. A valuable paper on the glass at Salisbury, is given by WINSTON in the Salisbury volume of the ARCHEOLOGICAL INSTITUTE, 8vo., London, 1849; *Illustrations*, s. v. 1861.

GRIS-GRIS, or Melley wood, from Sierra Leone, is said to resist the worm both in salt and in fresh water; CORRY, *Windward Coast of Africa*, 4to., London, 1807, p. 56.

GRITSTONE. A description of stone having a certain degree of asperity in its texture, by means of which it is able to reduce the prominences in another stone, or to grind the substance exposed to its action. It occurs in every geological formation, but principally amongst the sandstones, and the curious deposits formed from the shells of minute microscopic foramenifera. The grits are used for the purpose of producing an even surface upon marbles preparatory to their receiving a polish, and for grindstones. White gritstone is used in building at Chester.

G. R. B.

GRIZZLE. The term applied to the common brick burnt in a clamp, and having a mottled colour because the external air has been partially admitted to it by a settlement of the clamp while burning; BRICK, manufacture of, p. 139. They are harder and sounder, and not so red, as the place brick. A. A.

GROFING. A local term used in the following passage, "shingling, grofing, verges", etc.; but the explanation is not given.

GROFT. A term used in the mediæval period, as "gobetts, urnell, rag, grofts, sextefothers, doubles"; WILLIS, *Nomenclature*, 4to., Cambridge, 1844, § 36.

GROIN. This word signifies the external angle formed at the intersection of two vaults or portions of vaults crossing each other. The term has been improperly given to the spandril vaulting between groins, and even to the whole vaulting. The word is not now applied in any sense in the case of a testudo or coved vault, where the corners are, however, really groins. It is remarkable that the unsatisfactory method of executing groins in brick has continued to the present time, although a better one has been proposed by TAPPEN of a brick vaulting with **GROIN RIBS**, as described in his *Explanatory Remarks on a New and more effectual Method of Building Groined Arches in Brickwork*, 4to., London, 1819; which may be compared with the groins in the London docks, shewn in BRES, *Illust. Glossary*, 8vo., London, 1853, p. 213. A. A.

GROIN ARCH. The transverse arch (Fr. *arc doubleau*) which separates each severy or bay (*travée*), as A F D, Fig. 2, **GROINED VAULTING.** A. A.

GROINED CEILING. In joinery this is an imitation of a groined vault by oak timber ribs, having the spandrls filled in with thin narrow oak boards. In plastering this is a ceiling of timber ribs lathed and plastered to imitate a groined vault. Such occurs at Warmington church, Northamptonshire, of the Early English period, and several in Winchester cathedral which are of light coloured oak and so well executed as to resemble stone; also at Ely choir and York choir, and is common in work half a century old. Its difficulties are noticed in a paper by JOPLING, *On the Ribs of Groined Arches or Ribbed Groins in Plaster*, read at the Society of Arts, *Transactions*, etc., 8vo., London, 1820, xxxviii, 83. **CEILING.**

GROIN CENTRING. In brick or stone vaults without ribs it is usual to prepare a centre in the usual way for the main or body range, and to place the cross centring on it so that there is only one cutting to each point, which saves both labour and stuff. For the works on this subject, see **CENTRE**. In brick or stone vaults with ribs it is usual to fix simple curved pieces of timber to carry the vaulting ribs, using any light stuff to carry the spandrls, as each course when complete ought to lock itself. A. A.

GROINED VAULTING (Fr. *voute d'arête* because the groin is a *vive arête*). The system of vaulting in which the vaults cross each other as distinguished from barrel vaulting (Fr. *voute de berceau*). Its origin and its practice have been noticed s. v. **FORNIX**: the early mediæval groined vaulting was probably the same as that of the Romans, inclusive of the band or wide rib (Fr. *arc doubleau*) from wall to wall in the vault, so as to strengthen the barrel. The first difference seems to have been the introduction of ribs on the groins or lines of the intersection of the two arches, crossing each other, and having a boss or key at the intersection. These ribs (*nerfs en ogive*) were first simply chamfered and afterwards became moulded (**GROIN RIB**). Their introduction however entirely changed the system of construction. Instead of a continuous system of vaulting built on centring, the ribs were first put up, supported by light segments of timber, and when they were complete the spandrls (*remplissage*) were filled in with the lightest and thinnest material that could be obtained, the ribs being sometimes rebated at the back to receive them, and the haunches being generally loaded with sufficient concrete to counterbalance the pressure from the crown, which would of course give the haunches a tendency to rise. About this time (Later Norman period) partly for symmetry and partly to start the filling in of the spandrls, half ribs were constructed against the walls; these ribs retain their French name *formeret*. By this means also the vaults were divided into independent divisions or bays (*travées*), and it was soon found that by keeping up the point of intersection the groin was made much stronger. In consequence of this the longitudinal line or ridge, as the highest point of the vault is sometimes called, could not be level, but formed a sort of curve; this however mattered but little, as the curvature

would not be perceptible from below. Indeed it is a curious fact, that till lately the circumstance has not been noted, so little was it observed. Each bay became in fact not part of a continuous vault, but a sort of dome or flat cupola, depending for its strength mainly on that sort of principle of annularity by which a bricklayer domes over a common well. The filling

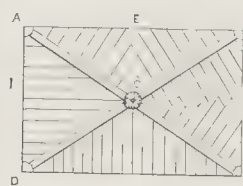


Fig. 1.

lines as in A B O, B C O. This produced such a clumsy intersection at E O, F O, as to give rise (it is supposed with much reason) to the introduction of the ridge rib and a second transverse rib (*second arc doubleau*), which hid these intersections.

The vaulting had now assumed the form as fig. 2, or as in the *Illustration*, s.v. **Groined roof** (Angers), but as in the Early English styles the clear-stories became larger and the triforiums less, and as the windows were so much increased in height, the second transverse ribs became first level, and afterwards were constructed so as actually to be above the line of the ridge rib. So that although the longitudinal section as before was as in fig. 3, the cross rib took the form of fig. 4. Of course the vaulting was much weakened by this change. To remedy this an intermediate rib, called after the French name *tierceron*, was added, as A B, B C, A E, E G, etc., fig. 5.

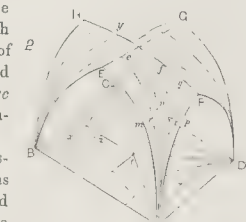


Fig. 2.

Fig. 3.

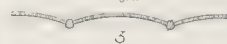


Fig. 4.

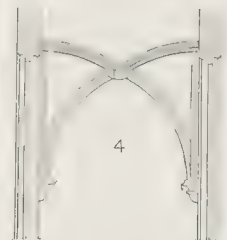


Fig. 5.

rious, and it was evident the architects wished to produce the effect of a network of ribs in forms most pleasing to the eye.

At length, about the period of the Perpendicular style, another series of ribs extending from one intermediate rib to another was introduced, which retain their French name *liernes*. These are shewn D to I, K to X, fig. 5. This complicated method was at last succeeded in the late Perpendicular style by two systems, one being called **FAN VAULTING**, the other called **STELLAR VAULTING**: in these methods the four centred, or Tudor, arch seems chiefly to have been employed. Flying groined vaults are vaults springing from corbels, each supporting a pillar and its capital, according to DALLAWAY, *Discourses*, 8vo., London, 1833, p. 173, but they are rather such vaults as those on the canopies of niches and some organ lofts and rood screens. Basket groining is merely a term for interlacing ribs, as in the cave No. 10 at Ajunta, or in the choir of the cathedral at Freiburg: although it is used by MACGAGNLEY, *Elements*, for the Tudor vaulting that springs on

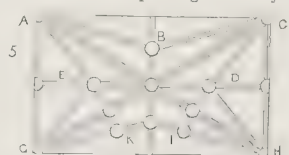
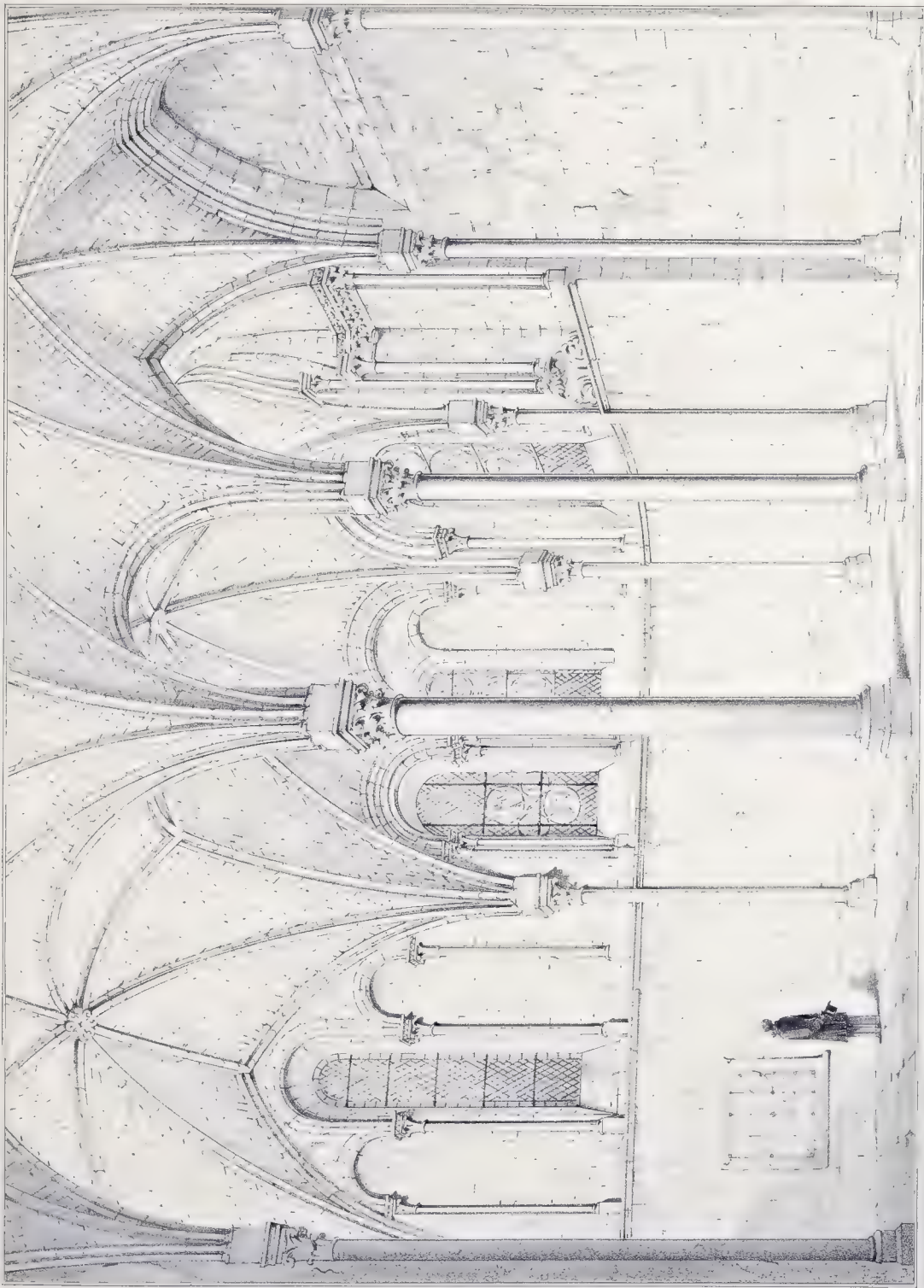
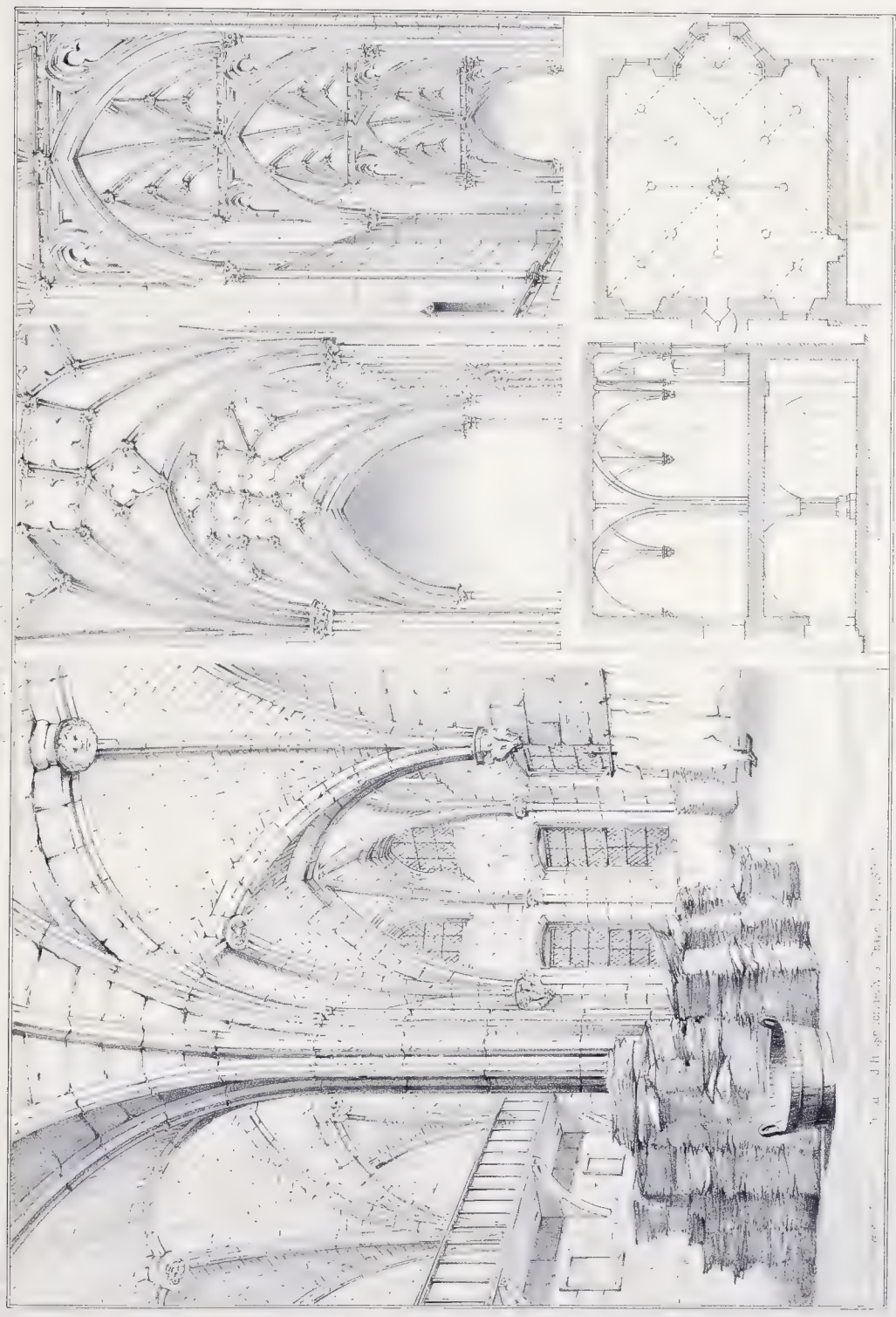


Fig. 5.





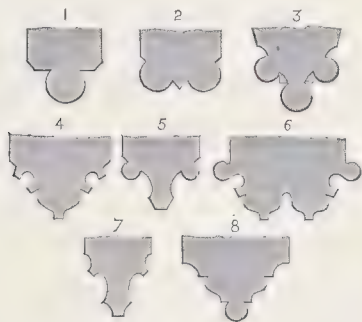




one side from a pendent boss. A very peculiar instance of mixed vaulting from Bristol is found in *Illustrations*, s. v. Groined roof. An ascending groined vault is one which leads from one level to another as those under the Adelphi. There is nothing peculiar about its construction except the methods of finding the lines for the centring which is given in NICHOLSON, *Carpenter's Assistant*, 4to., London, 1805; and in the work on *Carpentry*, published by Weale, 1845. Under-pitched or Welsh groined vaulting is one in which the body range is higher than the transverse vaulting. Among the books on this subject to which it may be worth while to refer may be named VIOLETT LE DUC, *Dict. s. v. Construction*, and GARRETT, *Principles of Design*, 12mo., London, 1850, pp. 171-195. A. A.

GROIN POINT. The name given by bricklayers to the aris or line of intersection of cross arches of vaulting executed in brickwork. A. A.

GROIN RIB (It. *costola*; Fr. *arétier*; *nerv*; *nervure*; Ger. *rippe*). The rib which conceals the joints of the spandrels (*remplissages*), the nomenclature of which is given s. v. GROINED VAULTING. The rib was first a plain square, afterwards chamfered, then relieved with a plain roll molding, as No. 1, which is very common in Norman work. It then took the form usual to other moldings in each style; 2, is from Glastonbury; 3, Robertsbridge; 4, Salisbury; 5, Tintern; 6, Rievaulx; 7, Clery; 8, Oxford. The arrangements of ribs at various periods are described s. v. GROINED VAULTING; FAN VAULTING; STELLAR VAULTING. A. A.



GROLOCK (BARTOLOMAEUS) built 1571-5 the universitäts-collegium at Altdorf near Nuremberg. 68.

GROOTE (JOHANN) built 1339-54 the choir of the Marienkirche at Wismar in Meklenburg-Schwerin. 92.

GROOVE (It. *scanalatura*; Sp. *muesca*; Fr. *rainure*; *glyphe*; Ger. *falz*, *fuge*). This word, formerly written 'grobe', according to JUPP, *History*, 8vo., London, 1848, p. 297, 302, and so apparently derived from the Ger. *grube*, a ditch, is used to denote any rectangular channel of which the depth is greater than the width. When the width exceeds the depth the channel is generally called a CHASE: the three sides and the section form the difference between the groove or CHASE, the ARRIS CHANNEL, the FLUTE, the QUIRK, and the THROAT JOGGLE. The groove was one of the earliest means of decoration applied to masonry, and it might be said to have furnished to Sir J. Soane his particular manner of embellishment, viz. the nebuly lines round the recesses in the walls of the rotunda at the Bank of England: a manner which seems to have been derived from some such hint as that afforded by the deep narrow lines cut under the projecting moldings of the octastylar portico-in *antis* opposite the north end of the temple to Hercules at Pompeii. In mediæval times the groove was used more as a matter of utility, e. g. for the reception of the leadwork of windows. CHAMP-ASHLAR. The French name for a groove-plane is *bouvet*; and for a piece of timber (whether

sill or post or head) grooved, *coulisse*. Carpenters and joiners seem to have been indebted to the introduction of the plane for their general application of the groove: indeed BLONDEL, *Cours*, 8vo., Paris, 1771, vi, 367, thought it worth while to notice that boards joined edgewise for panelling were to be made not with butt-joints, but to be "à rainures et languettes", grooved and tongued, or rather ploughed and tongued, to prevent their windings. A later practice, evidently derived from the masons, is the substitution of a slip of wood or, in recent times, a piece of hoop iron, for the tongue (Ger. *feder*); so that a groove (Ger. *nuth*) is made on the edge of each board, and the stuff is afterwards pressed together, and either glued in paneling, or free in flooring, or caulked. Various planing, tonguing, and grooving machines, worked either by hand or by steam-power, have been invented of late years; Newton's improvements are described in the *CIVIL ENGINEER Journal*, 1850, xiii, 169.

GROOVED BEAM. The name applied to π beams by TURNBULL, *Treatise on Cast Iron*, 8vo., London, 1832, p. 18, who gives formulæ for calculating their strength.

GROS (PHILIP) built 1332-40 at Nuremberg the rath-haus which was only one-third of the size given to it 1521 by H. Beham; portions may still be seen in the interior quadrangle and in the street at the back of the present edifice, which encloses its predecessors, and dates 1619. 68.

GROSS (JOHANN) was engaged 1760 as clerk of the works, 1771 as kontrolor, and 1775 as direktor, in the office of bridges and causeways, by the Austrian government. LANGSDORF, *Anleitung zum Strassen und Brückenbau*, 8vo., Mannheim, 1817, pl. xiv, p. 458, giving an illustration of the bridge near Szuczán in the Turóczer-comitat, notices the apparent cheapness of the nine timber bridges mentioned in the life of Gross as given by JEKEL, *Galiziens Strassen und Brückenbau nach dem Systeme des Herrn J. Gross entworfen*, two plates, 8vo., Vienna, 1809, p. 23; but adds that the cost of the material and of carriage was of course very little. He selects three of the most important; one erected 1782 at Tarnow over the Biala, 187 ft. span, costing about £900; another 1802 in the Arvaer Komitat, 250 ft. span, costing about £1400; and a third 1807 near Szuczán over the Waag, 337 ft. span, costing about £3,300. Gross died in September 1808, and was succeeded by his son ALOYS as strassen-bau-direktor for both Galizias.

GROSS (ORTOLF) was engaged 1482 on the dom at Wuerzburg, as *baumeister*. 92.

GROSSETO. The capital of the province of the same name in Italy. It is a small pentagonal fortified town with brick bastions and two gates. The cathedral, dedicated to S. Lorenzo, was commenced early in the thirteenth century, but the campanile dates 1402; the episcopal palace, at some distance, and the theatre, are of more importance than the two or three other churches and monastic establishments, the town-hall, or the hospital. At a distance of four miles were the ancient *thermæ*, rebuilt 1822; and two miles further, passing the torre Moscona, or ruins of a mediæval circular fortress, the traces of the walls of Rusellæ, remarkable for the size of the stones, some of which are from 6 to 8 ft. high and from 7 to 12 ft. long; the north and east sides have polygonal masonry, but the rest is rectangular work; there are also remains of inner walls and of a circular building with Roman vaults called an amphitheatre. Rusellæ was not deserted until the twelfth century. 28, 50, 96.

GROSSWARDEIN (Hung. Nagy Varad). A city, in the Bihárér-comitat in Hungary, consisting of the town proper, which is walled, and of eight villages or suburbs. The Roman Catholic cathedral, dedicated to the Virgin, was founded 1080 by Ladislaus the Holy, whose tomb, with that of king Sigismund, who died 1436, and his queen Maria, is still shewn. The structure itself dates from its reconstruction on an Italian model 1788 with two towers. The Greek Catholic cathedral, dedicated to S. Nicolas is considered a magnificent building; its bell tower was destroyed about 1840. The episcopal palace

and the comitats-haus, both modern, are more remarkable than the eight churches, the monastic establishments, the synagogue, the three great schools, or the hospitals. 26. 50.

GROT, GROTTA, or GROTTO (late Lat. *grupta*; Ital. *grotta*; Sp. *gruta*; Fr. *grotte*; Ger. *grotte*, said by SKINNER and MENAGE to be a corruption of 'crypta', a place of hiding; by others from the Anglo-Saxon *grafan*, to dig out, to hollow). A place built or dug out as a cave or cavern for coolness or pleasure; thus BACON, *Essays*, notices the grotta or place of shade. As a matter of pure building, the grotto appears to have been invented and brought to perfection in Italy before its introduction into France, where those made for Henry IV, 1589-1610, at his château-neuf of S. Germain, were admired for their novelty according to SAUVAL, *Histoire*, fol., Paris, 1724, ii, 303, as much, he supposes, as they would be afterwards admired for their (*grandeur*) size or magnificence. The term *grotte* is explained by BLONDEL, *Cours*, 8vo., Paris, 1771, iv, 183, as "espèce de petit bâtiment souterrain orné de rocailles, terminé en voûte, et souvent percé d'une lunette à travers laquelle on découvre le ciel: sur l'aire de ces grottes on place des bassins avec des eaux jaillissantes, et l'on pratique près d'elles de petites pièces pour y contenir des rafraîchissements"; as in the gardens at Noisy and at Montmorency. The grotto, as a work of architecture, was frequently used as a bath-house; even in England some grottoes still contain pools of water so cold as to be dangerous: its use as a bath appears according to RUGIERI, *Studio*, fol., Florence, 1755, iii, pl. 23, 24, in that designed by B. Ammanato at the bottom of the cortile to the palazzo Pitti; and by Vignola in the villa papa Giulio near Rome.

Grottoes and hermitages were common in the gardens of most country houses some years ago, but are not so much in fashion now. Some were small tasteless buildings stuck over with shells placed in set patterns; the best were imitations of natural caves. One at Pain's-hill in Surrey is very remarkable. This was designed by L. Brown, and is so skilfully carried out that strangers can scarcely be brought to believe it artificial. The soil is of Bagshot sand, perfectly dry, works easily, and stands at nearly a vertical angle. The grotto consists of several small caverns excavated in a hill, some of them opening on a very fine lake. These are lined partly with rock, and partly with spars and stalactites from Derbyshire, hanging down in a natural way. In a less judicious style, stuck over with shells, spar and pebbles, as if intended to vie with the celebrated grotta azzurra and grotta verde in the island of Capri, which are natural caverns, were such *ouvrages de rocailles* as that at Otlands, Surrey, said to have cost £40,000; and that for Mrs. Marryatt at Wimbledon House, both constructed by Bushell. At Wimborne S. Giles, Dorsetshire, the seat of the earl of Shaftesbury, is a grotto consisting of two parts; the innermost and larger one is furnished with a vast variety of curious shells disposed in an elegant manner; the outer, or ante-grotto, with ores and minerals of all kinds from different parts of the world: it was begun in 1751, and took two years to arrange; the total expense was £10,000. At Clifton, near Bristol, was another grotto equally celebrated. One of the most enormous grottoes in existence is in the ground floor of the new palace beyond Sans Souci, near Berlin; it is about 70 ft. square, the walls, ceiling, pillars, arches, etc., being encrusted with rock work, by Kambly and Müller.

Of grottoes constructed as retreats during hot weather, the most curious is that at the palace of Caserta near Naples. It is an apartment built under the bed of the river, which passes over it and falls in one thin unbroken sheet in front. The access is by stairs on each side. It was at one time the fashion to fit up a grotto like a HERMITAGE, but this is now out of vogue. The grotta della Zinzanusa near Castro is described by abbé Monticelli; Pope's grotto at Twickenham is noticed in WALPOLE, *Anecdotes*, etc., 8vo., London, 1862, 818. SERLE, *Plan of Garden, Grotto*, etc., 4to., London, 1745. GUERNIERI,

Disegno del Monte situato presso la città di Cassel—la cassa del Inverno, fol., Cassel, 1706; and *Description de la Grotte de Versailles*, fol., Paris, 1769.

Though the Italians use the word grotta for a natural cavern, the original word, *crypta*, apparently meant an excavation; and the Italians in some instances preserve that meaning: thus the crypta Neapolitana of SENECA is now known as the grotta di Pozzuoli; and the grotta Giulia, the grotta di Pietro della Pace, and the grotta di Seiano or di Posilipo, are also tunnels: English authors preserve the same meaning when describing the famous grotto of Antiparos, and the sepulchral galleries in Egypt, which are excavations: but French authors indifferently use the words *crypte* and *grotte*, so that it is sometimes impossible to decide whether a tomb, a cave, a quarry, a subterranean place, or a tunnel is intended; and it is remarkable that the word *grotte* is used in Provence, according to the comte de Gasparin, and in Normandy, according to M. Leprévost, to express the vault of a church, as noticed by the COMITÉ HISTORIQUE, etc., *Bulletin*, 8vo., Paris, 1842, ii, 475, which so explains the term *crotaine* as part of a church that was to be whitewashed 1513; and it may be added that the old French form was *crot* or *crotte*, whence the word *crottesque* in COTGRAVE, *Dict.*, fol., London, 1611.

A. A.

GROTESQUE (It. *grottesca*; Fr. *grotesque*). Anything strangely, uncouthly, whimsically, disproportionately, or extravagantly designed. The word is derived from grotto according to SKINNER, who says that figures of this kind were formerly sculptured in crypts, or were formed by the dripping of water eating into rocks or stones. The mixed figures of classic times, as the sphinx, griffin, etc., are generally too refined to be called grotesque under the present meaning of the word, yet the execution of the true grotesque although purposely omitting refinement, can only be conceived by those possessing the finest sense of the most delicate points of expression. In mediæval architecture, diabolical or fantastic figures are supposed to be representations of evil spirits, expressing their fear and hatred of the holy things around them. Sometimes they are caricatures of the religious orders, the monks as opposed to the friars, and *vice versa*; but on this subject reference should be made to the remarks by WRIGHT at the British Archaeological Association at Gloucester, reported in the *BUILDER Journal*, 1846, iv, 387; to which the illustrations in xviii, 448, and in KUGLER, *Kleineschriften*, 8vo., Stuttgart, 1853, might relate. Though grotesques may add a great deal of character to mediæval art, they should be sparingly used in the present day, as they sometimes degenerate into objects of ridicule. WRIGHT, *On the History of Caricature and Grotesque in Art*, in *ART JOURNAL*, 4to., London, 1863, *passim*.

GROTTE (LE). The modern name of AECULANUM or AECULANUM, in Naples.

GROTTESQUE, now written GROTESQUE. This term, as noticed in the preceding remarks, has during the last two centuries been employed in the sense of uncouth, whimsical, ludicrous, or misrepresentative, and the word arabesque has usurped its place in historical language. But while arabesque, as has been explained *s.v.*, properly means that delicate linear decoration which is seen in the capital letters and other illuminations of manuscripts, executed during the twelfth and three following centuries; (and which, except in cases where the scale of the work required enlargement of the strokes, still existed in the decorations designed by German artists in the beginning of the seventeenth century;) grotesque properly means work similar to that found in the ancient ruins called by the Italians *grotte* at Rome, as appears from VARCHI, *Lezioni*, 4to., Florence, 1590, p. 216; and BORGHINI, *Riposo*, 8vo., Florence, 1584, p. 492. Such work may be defined as ornament, neither mathematical (as a fret or a guilchoe), nor conventional (as a patera or a honeysuckle), but based on actual or possible forms, and varying in treatment from naturalism to conventionality: thus the subjects of pure grotesque work,

whether painted or sculptured, are foliage, flowers, and fruit with stems and tendrils arbitrarily entwined, and formed into scrolls or otherwise employed and mingled more or less with manufactured articles, architectural features, animals, and fabulous or monstrous creations; for instance, WOTTON, *Elements*, 4to., London, 1624, calls a terminal figure a piece of grotesca.

It does not appear that this departure from conventional forms of ornament, although indicated on a few of the Etruscan vases, was generally practised until the time of Augustus; the invention of the new style is usually attributed to Ludius, but is founded upon a misunderstanding of the statement made by PLINY, *H. N.*, xxxv, 10. Although it excited the sarcastic wrath of VITRUVIUS, vii, 5 (whose expression 'audacia Egyptianum in pictura' has been cited to justify a belief that the Greeks founded the style on Alexandrian rather than on Persian hints), the fashion spread rapidly, inasmuch that most classic buildings subsequent to his time may be cited as furnishing specimens of grotesque decoration. Excepting in the draconic ornamentation of the North (which may perhaps be partly referable to a Southern influence), the style seems to have disappeared until the dawn of the Renaissance. It was adopted by Ghiberti in 1400, and by his successors; but VASARI, *Vite*, intimates that Pietro Luzzo, called Morto da Feltro, about 1500, was the first to discover and restore the kind of painting called *arabesque* and *grotesche*, while Giovanni Nanni da Udine 1513-20 invented the stucco in which he executed in basso-relievo the grotesques in the loggie of the Vatican as assistant to Raffaello, whose patronage of this class of decoration appears to have established its reputation. Soon after the death of Giulio Pippi Romano 1546, the real grotesque was superseded by the grandiose-decoration seen in the works of Le Pautre, and although Audran practised it at Chantilly, Meudon, and Sceaux; and some appearance of a return to it exists in the works by Berain, by Gillot, and by Watteau, its true revival must be attributed to the discovery of the villa Negroni, and of Herculaneum, in the time of the architect Adam. The application of this style of ornament, whether modelled or painted, to ceilings, has furnished employment to many skilful artists who either disguised (like Correggio) the variations of surface by painted work or covered plain surfaces with a profusion of flowing ornament delicately modelled in stucco by hand. ENTRAIL; PHRYGIUM OPUS.

The treatment of the style has been thoroughly criticised by POYNTER, *Remarks on Arabesque Decorations*, read 23 February 1840 at the Royal Institute of British Architects, reported in the *Civil Engineer Journal*, 1840, iii, 30, and with illustrations in the same *Journal*, 1843, vi, 1; and by HITTOFF, *Parallèle entre les arabesques, etc.*, 8vo., Paris, 1844; and *Essay on the Arabesques of the Ancients as compared with those of Raphael and his School*, 4to., London, 1854, as the text to GRUNER, *Fresco Decorations, etc., in Italy*. CARLONI, *Terme di Tito*, etc., fol., Rome, 1776; BASOLI, *Compartimenti di Camere*, fol., Bologna, 1827; BORSATO and VALLARDI, *Opera Ornamentale*, fol., Milan, 1831; DEDAUX, *Chambre de Marie de Médicis*, fol., Paris, 1838; DE LA GUERTIÈRE, *Recueil des G. de Raphael*, fol., n.d.; METZMACHER, *Portefeuille hist. des ornemens*, fol., Paris, n.d.; PAPWORTH, *Specimens of Decoration*, 4to., London, 1844; REYNARD, *Ornemens—des XV à XVIII siècles*, fol., Paris, 1844; VOLPATO, *Ornaments of the Vatican*, fol., Rome, 1772-7; WATTEAU, *Ornaments*, from the orig. edit., by NICHOL, fol., Edinburgh, 1839-40; LE NOIR, *Nouvelle collection d'arabesques par Poussin*, 4to., Paris, 1810; ZAHN, *Wandgemälde in Pompeii*, etc., fol., Stuttgart, 1848; ZAHN, *Die Schönsten Ornamente—aus Pompeii, Herkulanum, und Stabie*, fol., Berlin, 1828-30; PESENTI, *Ornements d'Arch.*, 4to., Rome, n.d.; GOLDCUTT, *Specimens from Pompeii*, 8vo., London, 1825; ROSINI, *Le Antichità d'Ercolano*, fol., Naples, 1757-92; KILIAN, *Le Picturae Antiche d'Ercolano*, 500 pl., fol., Augusta, 1778-81; CAMPORESE, *Ornamenti Grotesche*, by G. da Udine, —; STEIGLITZ, *Sur l'empire des grotesques*

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et des arabesques, in the *Nouvelle Bibliothèque des Belles-Lettres*, xl; DALY, *Revue Générale*, ii, 210; PERGOLESI, *Designs for Arabesques, etc.*, fol., London, 1777-85; DURAND, *Parallèle*, etc., fol., Paris, 1801-9, pl. 81-2-9, 90; *Ornati d'invenzione di Raffaele—essistenti nel Coro di S. Pietro in Perugia*, fol., Rome, 1811; and PONCE, *Collection des tableaux et arabesques antiques trouvées à Rome, dans les ruines des Thermes de Titus, avec les arabesques des Bains de Licia, et de la Ville Adrienne, avec les plafonds de la Ville-Madame, d'après les dessins de Raphael*, fol., Paris, 1789-1819; with the continuation by DE ROMANIS, *Le Antiche Camere Esquiline dette—Terme di Tito*, fol., Rome, 1822.

GROTTI (FRANCESCO), born 9 June 1604 (1634 in NAGLER) of a noble family at Perugia, designed the tribunal of the Inquisition in that city, where he died 17 February 1679. His works for private individuals at Bologna, Ferrara, and Romagna, are not specified in the memoir of him given by PASCOLI, *Vite*, 4to., Rome, 1732, p. 197.

GROUND, see EARTH.

GROUND (It. and Sp. *fondo*; Fr. *fond*; Ger. *grund*). A term applied to the plane or surface upon which an object is placed as in relieved ornamental work (CHAMP), and to the colour of the surface upon which decorative painting, as grotesques, is applied.

GROUND or GROUND COAT (Sp. *baño*). That coat of paint applied when approaching the tint required for the finished work. It is also the tinted coat of paint laid on to receive the colour for grained work.

GROUND CILL, see GROUND PLATE.

GROUND FLOOR (It. *piano terreno*; Sp. *piso bajo*; Fr. *rez de chaussée*; Ger. *erdgeschoss*). The floor of a building that is either on a level with the surface of the ground, or a few steps above or below it. The whole story above the ground is sometimes called the ground floor, and there seem to be doubts whether in some acts of Parliament the term is meant to denote the basement or cellar story; *BUILDER Journal*, 1848, vi, 532.

GROUND GLASS, see GLASS, p. 45, and p. 47.

GROUND JOIST. The joist resting upon sleepers laid upon piers or dwarf walls to receive the flooring of the story next the ground: too often in cheap work the joist rests upon the ground itself; in some well built houses it rests on concrete, the spaces between the joists being filled in with the same material. Both joists and sleepers should be formed of oak, teak, or other hard wood, in the best work. 2.

GROUND NICHE. This term is said to be given to a niche having its base on a level with the floor. 1. 2.

GROUND PLAN. The plan of a house taken at the story that is level with the surface of the ground, or a few steps above or below it.

GROUND PLATE or GROUND SILL. The lowest horizontal timber on which the walls and partitions of a building are erected. Formerly it chiefly occurred in buildings entirely of timber, or of timber framing with brick panels: but after the fire of London it became usual to set the posts that carry the bressumer of a shop front on a ground sill, with the consequent disadvantage that where the latter rotted the bressumer has sank.

A SLEEPER is sometimes called a ground plate, but is not always supported for its entire length, which should be the case with a plate.

GROUND PLOT. The plan of the walls of a building where they first commence above the foundation. The term is more properly given to the piece of ground selected to receive the building. 1. 4.

A name given in old documents to a general delineation of premises to a small scale, which is now usually called a block plan. A. A.

GROUND RENT. An annual sum paid to the owner of land for permission to erect one or more structures thereon, such buildings to revert to and become the property of the owner of

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the ground after a stated period. This custom, it is believed, with very few exceptions, is peculiar to the neighbourhood of London. It presents the following anomalies. A freeholder has a field for which he gets with difficulty £5 per annum as garden ground, or as it is called 'occupation land'. A builder wishes to erect houses on it. The owner immediately demands a much larger rent than he has been hitherto receiving, and expects after a certain period to have the houses for nothing. The reasons for this are simply that the population of the metropolis increases very rapidly, and houses must be built to accommodate them. A very large portion of the land immediately in the vicinity of London is held either by the church, by city companies, by hospitals and other corporate bodies, or by the holders of large entailed estates (many indeed belong to noble families); all of which bodies or persons have power to lease, but not to sell their estates. The builders, finding there is no chance of buying, are forced to hire the ground; and after they have built they fix the rack-rent, or rent to be paid by the inhabitant, thus. An annual payment is calculated on the cost of the house, often called 'the brick and mortar rent', and to this the ground rent is added, and the rack rent is the result. This is calculated at such a rate that the builder may make a fair interest on his outlay, and also lay by such an annual sum as will (with its accumulations) amount to the value of the houses, which pass from him at the expiration of the lease, and so recoup him for the loss of them. It will thus be seen that however anomalous the course may seem, it entails no injustice on the builder. It has this effect however on the tenant at the rack rent, that he has not only to pay the builder the interest for his outlay, time, and trouble, but also an additional annual sum as a species of insurance or sinking fund, because the houses must pass from him, the latter, at a given time. It is for this reason tenants who can afford it pay down a premium for their leases, in which case the residue of the rent may be considered as an IMPROVED GROUND RENT. PREMIUM.

The value of a ground rent depends wholly on situation, the nature of which is twofold—the advantage of the site for business, or for residential, purposes. It is often said as an illustration, that a shop of the same size would cost no more to build on Salisbury Plain than in the Strand; but in one locality a stranger passes scarcely once a month, while in the other thousands of persons likely to be customers pass every hour. In the former case the tradesman could not pay even a small rent, in the latter he can pay a rent that seems extravagant. A house may cost no more to build in Belgravia than in Bethnal Green; but, from the superiority of the situation in point of society and fashion, it would let for vastly more in the one than in the other locality. It is clear, then, that the interest on the cost of the house, or the 'brick and mortar rent', may be but a small consideration in assessing its tenantable value, or it may be of the greatest moment. These circumstances regulate the demand, and the advantages are divided between the freeholder and the builder accordingly. In the suburbs of London, one-sixth or one-seventh of the rack rent is considered fair for the freeholder. In other words, five parts are 'brick and mortar rent' and one part ground rent. Near the Royal Exchange, so great is the value of the site, the reverse is the case. The greatest rent received for the smallest space covered is said to be for the privilege of erecting the book stalls at the railway stations, where large sums are paid annually for a space, perhaps, six feet long by a foot and a half wide; but this all depends on the business done, which again depends on the peculiar advantages of the situation. The railway companies are aware of this, and thus the amount is fixed by the relations of demand and supply. APPORTIONMENT; COMPULSORY SALE. A. A.

It has been formerly stated that "the builder should have every encouragement in respect of the allowance termed a grass, or a peppercorn rent, and also the progressive payment of the reserved or full rent, so as to give sufficient time for the covering of the ground and completing the residences, without

actually forcing the market, and admitting improved ground rents upon the remainder, consequent upon the speculator's successful operations. Upon granting leases, the division of the ultimate reserved rent should be in due proportion to the whole amount; or if either below or above that rate, in no case less than 40s., nor exceeding one-sixth of the improved or rack rent value of the substantial building improvements; as builders, in taking leases, will endeavour to charge the inferior portions of ground, or buildings erected, with a maximum amount, to relieve the vacant frontages or their residuary lease, in making up the whole rental"; NOBLE, *Professional Practice*, etc., 8vo., London, 1836, 97: and although part of the land may be leased at apporportioned rents, some carcasses should be left unleased until the entire number of buildings stipulated is erected.

Unsecured ground rents are now usually valued at twenty-five years purchase; but those secured at from thirty to thirty-three years purchase.

The amount of ground rent which a finished house will bear should not exceed one-sixth or one-seventh of the rack rental, unless in situations where rents and prices are very high. A larger proportion, indeed, is an impediment to a sale or a mortgage of the building; and most builders would not pay more than one-eighth or one-tenth for the ground. Speculators of considerable capital, renting a large quantity of land to be covered by degrees, or for the purpose of underletting in detail, will of course pay only the wholesale price, with covenants in the lease of a not very restrictive nature. Besides which they may fairly require two years peppercorn rent instead of the usual twelvemonth's, or else a graduated rental; BUILDING NEWS *Journal*, 1860, vi, 871.

GROUND RENT; IMPROVED. It frequently happens that a builder takes a large piece of ground at a wholesale price, erects houses upon it, and sells the same for a sum subject to a larger ground rent than he pays the freeholder. This is called an 'improved' ground rent, but though perhaps equally well secured, it is not worth so much as a freehold ground rent, as the ultimate reversion devolves on the freeholder, while the holding is clogged with the covenants of the superior leases, and the danger from breaches of covenants. A. A.

GROUND. Rough wood skeleton frames fixed to solid construction to receive the joiner's work. For doorways, the back and front grounds were connected by a third, in a manner specified as dovetailed backing. Narrow grounds were the technical name for those to which the bases and surbasses of rooms were fastened. Skeleton grounds have fallen into disuse, and the grounds of a doorway are now the wrought woodwork, carrying moldings, forming a single or a double faced architrave, and having the jamb space filled by a single or a double rebated and beaded jamb lining. The grounds serve as screeds to the plastering, for which purpose the narrow sides of them are chamfered, rebated, or grooved. The grounds, framed or otherwise, for skirtings disappeared as soon as slips of wood set against the wall or partition were thought sufficient to hold the finished work. All these appliances were formerly fastened to wood bricks, but in some public buildings recently erected wooden plugs or wedges were driven, as in the commonest old work, into the joints of the brickwork, to which the grounds were nailed. Grounds are not now much used for BOXING SHUTTERS. ARCHITRAVE. I. 2.

GROUND SILL, or GROUND SELL. A country term for the foundations of a building. SILL. It is also sometimes used for the lower parts of old buildings; GROUNDWORK. The following old spellings also occur: in 1463, John Baret desires to be buried "in a pet under the groundsille ther my lady Schar-delowe was wont to sitte", Bury Wills, p. 15: 1543, "for stone—to grounde soole of—kitchinge, super pavimento, 6d.": 1519, "our wher stallyng is defectiff in gronsoll", SURTEES SOCIETY, *York Rolls*, 8vo., Durham, 1859, 110, 272, 344. JUNIUS, *Nomencl.*, 12mo., London, 1585, 213, has *Hypothyrum*,

Fr. *le seuil d'un huis*, the ground sell or foote poste of a doore; the threshold. BINGHAM, *Origines*, 8vo., London, 1840, ii, 419, speaking of the *solea*, notices that it has been fancied that this word "might signify the *limina cancellorum*, the threshold or raised foundation upon which the rails of the chancel were erected, and be so called from *solum*, whence comes the French name *seuil*, and the English sill or groundsel."

GROUND TABLE STONE, or EARTH TABLE, or GRASS TABLE, is explained by WILLIS, *Arch. Nom.*, 4to., Cambridge, 1846, as the chamfer of the plinth; but in the GLOSSARY, as the projecting course of stones in a wall immediately above the surface of the ground, now called the plinth; and in NICHOLSON, *Dict.*, as the top of the plinth. In the first sense it is used in the contract for Fotheringay church, p. 20; and the two latter in WYCESTRE, *Itinerary*. BASE OF A WALL.

GROUND WORK. Although the passages "foundation or groundworke, Lat. *fundamentum*, *fossa ubi sit substructio*", i. e. a trench for the footings; and "groundworke or foundation of earth, Lat. *solum*, Fr. *fond de terre*", i. e. the rammed bottom of such a trench, occur in JUNIUS, *Nomenclat.*, 12mo., London, 1585, p. 199, the term ground work is now generally applied to the operations connected with the addition, alteration, or removal, of ground as may be dictated by the instructions or plans given by the landscape gardener for drives, walls, terraces, ponds, lawns, beds, etc.

GROUPED PILLARS. There is a difference between English and French writers in their use of the words grouping and *agroupement* as applied to the arrangement of pillars. The former word is restricted to cases of clustered (i. e. inosculating) work; while the latter is also applied to instances where three or more disengaged pillars stand close to each other, which the French authors would cite as an instance of partial *accouplement*. In the First Pointed style it is usual to find a large central shaft, generally circular, with smaller shafts, usually four, round it; as at Canterbury c. 1178, and Salisbury c. 1230, GLOSSARY, pl. 24, 27; or ten, as at Lichfield c. 1260, pl. 150; these are frequently made of a finer material than the rest as polished marble, but are often worked in courses with the body, and are sometimes filleted; they are very constantly banded.

GROUPING. The accidental or contrived connection of two or more objects. The commencement of a consideration of the effects produced on a church by juxtaposition with hills, water, woods, and buildings (which might well be extended to other structures), will be found in the *ECCLESIOLOGIST Journal*, 1845, iv, 264.

GROUT, from the Anglo-Saxon *groat*, the grits or grounds of anything (Fr. *bain de mortier*, *coulis*). Lime and sand mixed with a quantity of water till it is perfectly fluid, and poured from a pail on the courses of brickwork (every four courses is usually specified), as they are severally laid, to fill up any vacancies or places where the mortar has not been flushed up. There has been great controversy as to the value of this method; it has been urged with much probability that the extra quantity of water imbibed by the bricks from the grout keeps the work wet so long that there are chances of settlement. Perhaps the question is best summed up thus: if the joints of the brickwork are well flushed up with mortar there is no need of grout, if they are not so done they ought to be; and in large work the application of grout tests the fact. Grout, however, may be used in the last courses of brick barrel arches or groins, thus. When the brickwork is carried up to within a few courses of the crown, dry bricks without mortar are wedged tightly in to form the key, so as to be "brick and brick" as the workmen express it. The back joints are then filled up by pouring hot grout into the interstices, so that the pressure of the arch at its vertex is on the bricks themselves, and not on the mortar joint. BRICKWORK, BEDS AND JOINTS OF. A. A.

A weak solution of lime in water used for the purpose of flushing in the joints of brickwork, when that is so badly

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flushed up as to render such a course necessary. It is evident that the great quantity of water used must be an obstacle to the setting of the lime or cement; and therefore grouting should only be resorted to in case the materials should be very porous and absorbent, or the labourers should neglect to flush up their work. The use of grouting is, in fact, a proof of bad execution, or of bad materials.

G. R. B.

A carefully prepared specification for constructing wharf walls, etc., defines the mortar to be made of one bushel of well burnt unslacked Dorking or Merstham grey chalk lime, or Halling lime, to three bushels of clean Thames sand; the mortar for grouting to consist of one bushel of lime to four of sand. FLUSHING. DENISON, in *Papers of Royal Engineers*, 1839, iii, 134; and 1840, iv, 208, gives *Notes on Injecting Beton and Cement Grouting into Leaky Joints of Masonry*. PASLEY, *Limes, Cements*, etc., 8vo., London, 1838, says, p. 40, that though cement should never be used for making concrete, in building with cement, there is, however, no objection to cement grouting, which, when pure cement is used, may be made by mixing up the calcined powder with water only, but in building with cement and sand, the latter ingredient also may be added to form part of the grout.

It is sometimes stated that the mediæval builders used a large amount of grouting in the rough rubble walling of their buildings, and especially in forming the stairs and vaulting. The following extract is noticeable: "The walls of the Castle of Galvall in Banffshire, 119 ft. x 24 ft. within, and divided into two—were 8 ft. thick, built up in frames of timber for keeping in the fluid mortar which was poured into the dry stone wall when raised to a certain height; the front and corners were finished with freestone from the Duffus quarries, twenty miles away: it was built about 1200"; FORSYTH, *Beauties*, 8vo., Edinburgh, 1806, iv, 466.

DE LASSAULX remarks that "the mistaken opinion that all plaster walls (*Gussmauern*) are Roman works, and that the stones were first built up dry, and afterwards plastered with fluid mortar, is so generally diffused, and, on the Rhine, leads to so many false historical conclusions, that the writer thinks himself obliged to begin with the refutation of both errors"; WHEWELL, *German Churches*, etc., 8vo., Cambridge, 1842, 148.

GROVES (JOHN THOMAS) exhibited drawings at the Royal Academy of Arts, London, in 1778 and 1780; and on his return from Italy, the "temple of the Sybil at Tivoli" in 1791; with "Three hermits of Rocca di Passa" in 1792. He was appointed 17 June 1794 clerk of the works at S. James's, Whitehall, and Westminster, in the office of the Board of Works, succeeding "Mr. John Soane, resigned"; and thus in March 1796 arranged the Chapel Royal, Whitehall, for the christening of a daughter of the Prince of Wales. Shortly before 1797 he erected Broomfield lodge, Clapham Common (west side), for the late Hon. Edward James Eliot; engraved in RICHARDSON, *Vit. Brit.*, fol., London, 1802-8, i, pl. 18; in 1807 he was architect to the General Post Office; and to the Ordnance Office in Old Palace Yard; and surveyor to the first commissioners for the improvements of Westminster around S. Margaret's church. Among his executed works are: 1807, the cenotaph on Portsdown-hill, near Portsmouth, to the memory of Lord Nelson; Moreton or Merton, for Abraham Goldsmid, Esq.; the baths at Tunbridge Wells; and the restoration of portions of Ely cathedral, including a new pulpit, etc. He died at his house in Great Scotland Yard, of a paralytic stroke, 24 August 1811, leaving his freehold property at Great Marlow, Buckinghamshire, to his son John Richard; he also had three daughters. Charles Bacon was a pupil, and succeeded him in the office of clerk of the works, etc.

W. P.

GROWING SHORE. In underpinning it was formerly the custom to support the superincumbent weight by upright shores, which were removed one by one as the brickwork was

executed. Very often, however, they were left standing, and the brickwork built round them; in this case they were called growing shores. DEAD SHORES or DEAD MEN.

GROZING IRON, see EMROD, and GLAZIER'S TOOLS.

GRUAMONS. The architrave of the principal portal of the church of S. Andrea at Pistoia represents the Adoration of the Magi, and is inscribed "Fecit hoc opus Gruamons magister bon. et Adodat. frater eius: tunc erant operarii Villanus et Pathus filius Tignosi A.D. MCLXVI", according to CIAMPI, *Notizie inedite*, 4to., Florence, 1810, p. 24, who p. 25 notices that the architrave of the north portal of the church of S. Giovanni Fuorcivitas at the same town represents the Last Supper, and is inscribed "Gruamons magister bonus fecit hoc opus." RUMOHR, *Ital. Forschungen*, 8vo., Berlin, 1831, i, 258, considers the date as a forgery; a matter of little consequence if he was sculptor, and not architect, and indeed on two of the capitals below the Magi is "Magister Erricus hoc fecit."

GRUBENMANN, frequently but improperly written GRUBEMANN (JOHANN and ULRICH). The best account, and that here followed, of these brothers, carpenters, at Teufen in the canton of Appenzell in Switzerland, seems to be that given in EBEL, *Schilderung*, 8vo., Leipzig, 1798, i, 389-93. ULRICH designed 1755 and completed 1758, at a cost of 90,000 florins or about £8,000, a covered timber bridge 364 Eng. ft. in length over the Rhine at Schaffhausen in two spans, that nearest the town being 171 and the other 193 ft. long, joining on a pier 8 ft. up the stream out of the direct line between the abutments; this bridge, burnt during the retreat of the French 13 April 1799, is given in EBEL; in KRAFFT, *Charpente*, fol., Paris, 1802-5, i, 27; and in RONDELET, *L'art de Bâtir*, fol., Paris, 1812, pl. 142. WHITELAW and WALSH, *History of Dublin*, 4to., London, 1818, ii, 956, notice that COXE, *Travels in Switzerland*, 8vo., London, 1789, i, 7-10, 33, saw the bridge when it was undergoing a thorough repair in 1785-6 by Spengler of Zurich; that ANDRÉE, *Briefe aus der Schweiz*, 4to., Zurich, 1776, gives two engravings of it, with a good description by Christoph Jezeler (which has been separately printed); and that a model 16 ft. 1 in. long, being to a scale of nearly one inch to two feet, was presented 1771 to the Dublin Society by the earl of Bristol, bishop of Derry, who had it made by a nephew Ulrich. EBEL states that Ulrich proposed to build at Derry a similar bridge 600 ft. span without piers, but that his plan was not accepted; and WARR, *Dynamics*, 8vo., London, 1851, 172-3, has a note that a model of such a bridge for Derry was exhibited in Paris by a sieur Claus. This bridge of Derry was published by SHANAHAN, *Designs for Bridges* (engraved at Venice, but without date or locality of publication); the plate shows two spans of 400 ft. each and a pier 16 ft. wide in the centre: but COXE, *Sketches*, 8vo., London, 1779, i, 13, says that Ulrich had agreed for £20,000 to throw a bridge 400 ft. span with 100 ft. abutments over the Foyle at Derry where it is 600 ft. wide.

JOHANN built also 1755-8, according to EBEL, a timber bridge 240 ft. long over the Rhine at Reichenau near Coire, which shared the same fate of conflagration; LUTZ, *Nekrolog*, 8vo., Aarau, 1812, p. 184. But COXE, iii, 183-5, mentions two such bridges at Reichenau, one being about 105 ft. long over the Bas-Rhein, and the other over the main stream below the infall of the smaller river in one span of 220 ft., but not so beautiful as that at Wettingen; he ascribed them to the nephew.

Together they built 1759 the timber bridge over the Linth between Glaris and Nettstahl; and a covered bridge 200 Eng. ft. in length in one span over the Limmath, near the abbey of Wettingen in the bailliage of Baden: this bridge rose 20 ft. above the level of the water, and was burnt soon after the others (LUTZ): it is shewn by KRAFFT, iii, 28; and from a drawing by John Soane in EBEL, and in COXE. In addition to these structures, EBEL says that they afterwards built in several parts of the country, churches remarkable for the bold pyramidal form of the tower, and for the absence of internal

columns, the roof being carried by timber arches hanging on the walls. Illustrations pretending to show the Schaffhausen and Wettingen bridges are given in CRESSY, *Encyc.*, p. 1373-5; but the long elevation therein lettered as the bridge over the Limmath is evidently an error, as it does not correspond with the half elevation to a larger scale on the previous page: perhaps this fault may be due to some mistake made by GAUTHIER, *Const. des ponts*, edit. Navier, 4to., Paris, 1809-19, ii, pl. 3, in copying from MECHÉL, *Plans, etc., des trois ponts de bois les plus remarquables de la Suisse*, Bâle, 1803.

LUTZ speaks of Ulrich as passing the latter portion of his life as a convert in the abbey at Wettingen: while from COXE it would appear that in 1776 he had died some years previously; and COXE saw the brother or nephew, he did not accurately learn what was the connexion: probably Ulrich and Johann were brothers, and the nephew Johann Ulrich, which may explain the confusion made by writers (other than EBEL), who differ in almost every instance from each other as to names, dates, and dimensions.

GRUBER (GABRIEL), a Polish architect, born 1738, died 1805.

GRUENBERG (MARTIN), born 1655 in Prussian Lithuania, left 1680 to study in Italy and France at the expense of the elector of Brandenburg, who gave him 1695, on the death of Nehring, the post of chief architect; in which capacity he continued the *schloss* at Potsdam, and 1697 the arsenal at Berlin; the latter building, however, was soon entrusted to Schluter, and was so altered 1700 by De Bodt as to become that architect's work. Gruenberg designed at Berlin 1699 the old Werdersche-kirche; 1700-3 the stern-warte; the portal of Nehring's parochialkirche; 1701-3 the garnisonskirche; 1701 the new church constructed in the Friedrichsstadt from his drawings by Simonetti; and 1702 (other accounts say 1697) one wing of the court and the front next the Stralau-strasse of the Friedrichswaisenhaus to which the church, tower, and water-front were completed by Gerlach after the death 1707 of Gruenberg, who designed the Köllnische rathhaus (commenced 1709) and a considerable number of private houses. NICOLAI, *Beschreibung*, 8vo., Berlin, 1786, i, 124; iii, app. 89.

GRU-GRU. The native name for the wood of the ACROCOMIA.

GRUMBOLD, GRUMBOLD, or GRUMBALL (ROBERT), was the "master workman" 1593 in completing the tower of the church of S. Mary the Great at Cambridge, and received 9s. per week; J. Warren was the builder employed at the completion of the tower in 1608; LE KEUX, *Memorials of Cambridge*, 4to., Cambridge, 1841.

A John Grimbald was the "builder" of the river front of Clare hall 1635-8, the parapet of which is decorated with stone balls, similar to those which until within the last few years surmounted the pinnacles of S. Mary's: ARCHÆOLOGICAL JOURNAL, xii, 245, 252-5; Transactions Cambridge Camden Society, 255; GENTLEMAN'S MAGAZINE, 1860, ix, 55.

FULLER, *Hist. of Univ. of Camb.*, by PRICKETT and WRIGHT, 8vo., Cambridge, 1840, p. 87, states that "Mr. Barnabas Oly, late fellow—and proctor of the university (1635) may truly be termed Master of the Fabrick, so industrious and judicious was he in overseeing the same." In the same work, edit. by NICHOLS, 8vo., London, 1840, p. 60, he says the first stone of the college was laid 19 May 1638.

The bridge of three arches at Clare hall "was made after the plan of one Grumball (cir. 1638), who received about 3s. (5s. 6d. in GENTLEMAN'S MAGAZINE) for his trouble. The Grumballs were a family who came from Raunds in Northamptonshire"; WILKIS, at Congress of Arch. Societies at Cambridge, *Report*, 8vo., 1860, p. 8.

BRIDGES, *Northamptonshire*, fol., 1791, i, 188, records that "at Raundes was born John Grimbald, who built Trinity College library (1677-80 under Sir C. Wren) and part of Clare hall in Cambridge, who died lately advanced in years"; BRIDGES died in 1724.

GRUNDA, see SUGGRUNDA.

GUADALAJARA or GUADALAXARA. The capital of the department of Jalisco or Xalisco in Mexico. By reason of its straight and wide streets, which are not paved, and its low houses, it would not at first sight seem one of the finest and most considerable cities in Southern America; but its buildings seem to warrant that character. Fourteen *plazas* with as many fountains are supplied by an aqueduct fourteen miles in length: the *alameda* is well kept. The chief edifices comprise the cathedral, dedicated to the Assumption, still a large and splendid building in a bizarre style; the cupolas of both its towers were destroyed by the earthquake of 1818, as shewn in NEBEL, *Voy. Pitt.*, fol., Paris, 1836; it occupies one side of the *plaza mayor*, another being filled by the government house, and the two others by *portales* or ranges of arcades with rooms over which form the bazaar of the town and are better built than those at Mexico: the church of S. Francisco, almost as magnificent and in a more regular style, with a convent so large as to include four other churches: the Augustinian church; four other monasteries, and six nunneries: the university, formerly the Jesuits' college; and five other educational establishments: the episcopal palace near the cathedral: a fine mint: and two hospitals. 14. 50.

GUADIX. A small and old, but strong, city in the province of Granada in Spain. A large piazza with columns erected in the fifteenth century; the cathedral, dedicated to the B. V. Maria de la Encarnacion, of Doric and Corinthian orders, with stall work of the most exaggerated plateresque work; an episcopal palace at some distance; a ruined Moorsque castle; four churches, one of them being three-ailed; the remains of nine monasteries and three nunneries; a court house; a prison; five large schools; and the hospital in the college formerly belonging to the Jesuits; and six fountains, are to be found in ill-paved streets with poor houses in many cases only lighted by the doorway. 28. 50. 96.

GUAGE, generally, but improperly, so written; see GAUGE.

GUAIACUM OFFICINALE and G. sanctum, both probably yield the *LIGNUM VITÆ* of commerce, imported from Cuba, Jamaica, S. Domingo, and New Providence, in logs from 2½ to 36 ins. in diameter. The wood is cross grained, covered with a smooth yellow sap like box, almost as hard as the wood, which is of a dull brownish green colour, and when first cut is soft, but becomes harder. This is one of the heaviest of woods, being heavier than water, and is used for little else than in turning, and for rollers, castors, etc.; HOLTZAPFEL, *Woods*, 8vo., London, 1843, p. 90. 14. 71.

GUAL (BARTELOMÉ), as maestro mayor of the cathedral at Barcelona, was one of the eleven architects whose opinion was taken 23 January 1416 upon the course to be adopted in the erection of the cathedral at Gerona. 66.

GUALDE or GAYLDE (JEAN), master mason at Troyes, was buried under the *jubé* executed, if not designed, by him, which is still perfect, in the church of Ste. Marie Madeleine, and is shewn in ARNAUD, *Dép. de l'Aube*, 4to., Troyes, 1837, p. 198; and in PUGIN, *Chancel Screens*, 4to., London, 1851.

GUALTIERI, see CIMABUE (GIOVANNI).

GUAMANGA, in Peru, see HUAMANGA.

GUANAJUATO or GUANAXUATO. The capital of the department of the same name in the Mexican Confederation. The principal church, shewn in NEBEL, *Voy. Pitt.*, fol., Paris, 1836, several churches, and the *alhondiga* or public granary, are the only structures deserving remark, except that most of the houses, although built with hewn stone, are painted light green or some other lively colour. The town really consists of a number of villages corresponding with the gold and silver mines. 50.

GUARDA or GUARDIA. A walled city with a castle in the province of Beira-Baixa in Portugal. The cathedral, dedicated to the Virgin, four parish churches, a monastery, a nunnery, two large schools, as many hospitals, and a large but mean

episcopal palace at some distance from the cathedral, are the principal buildings. 28. 50. 96.

GUARD BAR. An iron bar placed inside or (more generally) outside a window, either perpendicularly as in basements, or horizontally as in nurseries: the distance between guard bars in the clear is usually about five inches.

GUARD CHAMBER (Fr. *chambre des gardes*). The room in which a portion of the guards of a distinguished personage remained at ease when on duty while not actually posted. PYNE, *Royal Residences*, 4to., London, 1819, shows several of such rooms fitted up with armour.

GUARD HOUSE (It. *corpo di guardia*; Fr. *corps de garde*). The building in which soldiers are accommodated while a portion of them are detached for duty in the guard chamber or as sentinels: it formerly contained merely a large room for the men who were relieved, and a smaller one for the officers. An example is to be seen in the lower ward of Windsor Castle, erected by A. Salvin in 1863.

GUARDIA ALFIERA. A small city in the province of Sannio in Naples, which, having been nearly destroyed by an earthquake 26 June 1806, has no remarkable building inclusive of its cathedral dedicated to the Assumption of the Virgin. 50. 96.

GUARD ROOM. The room, in a guard house arranged according to the modern custom, serving as the day room for its military occupants. The term has also been applied to the chamber in which the persons appointed to watch during the night over the safety of a church are supposed to be sheltered. EXCUBITORIUM.

GUAREA TRICHILOIDES, called in Jamaica, Alligator or musk wood. BULLET WOOD.

GUARENGHI, of some authors, see QUARENGHI (GIACOMO).

GUARINI (padre don CAMILLO GUARINO), born 1624 at Modena, became 15 April 1641 a Theatine monk at Rome; TIRABOSCHI, *Bib. Mod.*, 4to., Modena, 1786, iii, 37, prints a copy of the brevet giving the direction of the works at the royal chapel, with an annual salary of 1000 silver lire, 19 May 1668. Amongst his publications, those chiefly relating to architecture were the *Modo di misurare le Fabbriche*, 8vo., Turin, 1674, and *Disegni d'Architettura* (engraved 1680), fol., Turin, 1686. The latter gives illustrations of the following edifices, apparently built by him; viz. at Turin, the porta del Po; the *cappella reale* or chapel of the S. Sindone or S. Sudario, attached to the cathedral, and supposed to be his masterpiece; the Theatine church of S. Lorenzo, finished 1687; the church of S. Filippo Neri, commenced 17 September 1676 but, as its cupola in falling 26 October 1715 destroyed the rest of the edifice, the church as at present seen is the design of Juvara; the palace of prince Philibert of Savoy; and the palazzo Carignano, now accommodating the council of state, the chamber of deputies, and the post office, with other government offices: at Casale the cupola (? church) of S. Filippo Neri; at Racconigi a palazzo Carignano: at Vicenza the church of its townsman S. Gaetano di Thiene, founder of the Theatines (MILIZIA states that this building was the design of Frigimelica and finished 1730): at Verona the tabernacle in the Theatine church of S. Nicolò: at Nice a church of S. Gaetano: at Messina the church of the PP. Somaschi; and the church called La Nuntiata: at Lisbon the church of Sta. Maria de la Divina Providencia: at Prague the church of S. Maria von Alten-Oetting, probably that known as the (formerly Theatine) kirche zu unserer lieben Frau von der Vorsicht, built 1672: and at Paris the Theatine church of Ste. Anne-la-Royale near the quai Malaquais. The first stone of the latter building was laid 28 November 1662; but the building, commenced with a legacy bequeathed by cardinal Mazarin, was only partially erected when the fund failed; enough was gained by a lottery 1714 to carry out an alteration of Guarini's design by Lievain 1714-20, except the *portail*, which was finished by Desmaysens

1747; the plan with the new portal is given in BLONDEL, *Arch. Franç.*, fol., Paris, 1752, i, 290; the building was destroyed about 1820. The other structures attributed to him are, at Turin, the citadel; the church of S. Andrea called la Consolata 1675-1705; the palazzo Provana di Collegno; and the collegio de' nobili, altered 1784-7 by Galliari for the palace of the Academy of Sciences: at Vicenza the church of the nunnery called Araceli: at Modena the citadel, and the Theatine monastery; to which some authors add the church of S. Vincenzo, but TIRABOSCHI says the church of S. Gaetano: at Fossano the cathedral dedicated to the Assumption and to S. Giovenale: at Paris the house of the Theatines: and at Lisbon another. To these may be added a church of the Madonna dell' Oruppa, or more properly del Monte Oropa di Biella, shewn in the *Disegni* without mention of locality. He seems to have returned to Italy from France about 1668, in which year he was appointed royal architect, and to have died 6 March 1683 at Milan. The PP. Chierici Regolari di S. Lorenzo published his *Architettura Civile*, fol., Turin, 1737. Italian writers still speak "del genere borrominesco e guariniano". DE BONI, *Biografia*, 8vo., Venice, 1840.

GUARINI (fra GIOVANNI) was a pupil of F. Grimaldi, and a lay brother of the Theatines. He designed the church of Sta. Maria Donna Regina, commenced 1620 at Naples: and 1658 added the monastery to the church of Sta. Maria degli Angeli a Pizzafalcone, erected 1600 by Grimaldi. 95.

GUARINI, see GUERINI (Rocco).

GUARNERI (TEODORO or TEODOSIO) was the architect employed 1309 to build in a Pointed style the large church of the Augustinians at Cremona, of which 1558 the interior was modernized. Its original state was a basilica 191 ft. 6 ins. long and 69 ft. wide, without the chapels. 57. 62.

GUARO, see ALIO (MATTEO and TOMMASO).

GUAS (JUAN) was maestro mayor of the cathedral at Toledo, probably from 1481 until 1494, in which year he was succeeded by H. Egas. 66.

GUASTALLA. A walled city with a castle, made 1828 an episcopal see, in the province of Parma in Italy. The cathedral, dedicated to S. Pietro, and consecrated 1575; the annexed episcopal palace; several churches; a monastery and a nunnery, are the chief buildings. OFFO, *Istoria della città*, 4to., Guast., 1785-7. 28. 50. 96.

GUATEMALA, properly S. Jago de Guatemala (It. Guatimala). The capital of the state of the same name in Central America. The first town, founded 1524-7, was destroyed soon after 1541 by water from one of the two neighbouring very remarkable volcanos. The second town, built about twenty-six miles to the westward, and now called Guatemala la Antigua, or Antigua de Guatemala, extended about 7,500 ft. in length from east to west, and 6,000 ft. in width, and contained a population of about 60,000 souls, when earthquakes in 1773 reduced it to a mass of rubbish except the few well-constructed edifices which withstood the shocks with little injury: yet two sides of the central plaza still remain, with the ruins of a double-transepted cathedral, the largest in South America, about 600 ft. long and 200 ft. wide, described as built of hewn stone (in a Gothic style, according to DUNLOP) with richly carved arches and columns; and of a fine *palacio* or a town-hall, formerly two stories high, also built of hewn stone, the upper story destroyed; and about a hundred churches with more than twenty monastic establishments. About twenty thousand persons (half that number seems more probable) are said to inhabit these buildings, and to use about twenty-five of the churches for divine service. The plan of this town, and even the situation of the chief buildings, were repeated in the erection 1776 of the new city, Guatemala la Nueva, Santiago de Guatemala, or simply Guatemala, at a distance of ten miles northeastward of the ruins. This, like almost all the other Spanish cities in America, is built in *cuadras* or blocks of houses, each of 100 varas or about 330 ft. square, forming

straight and clean streets about 40 ft. in width, leading in the direction of the cardinal points to some important building, but although furnished with foot-ways and partially lighted, they are badly paved and have a central gutter. The city is square and about a mile in length and width, with six gates, two of which have bridges over the ravine that defends it on three sides. The houses stand each in its smaller *cuadro* forming a garden, and are only one story high with tiled roofs round one or more courtyards, each having a portico of wooden posts: these dwellings are built of stone plastered and whitewashed except the quoins and jambs, which are dressed; but they seem gloomy, as they uniformly present a plain doorway, with a few small, iron-barred, windows. Two aqueducts, each about six miles in length, one being carried for several hundred yards on lofty arches, convey water to twelve public reservoirs and fifty fountains, from whence it is carried by hand to the houses. The plaza occupies the space of four *cuadros*, and has a central fountain: on the west side are the government house and law courts, with the mint behind them; on the north, the *cabildo* or town-hall, with the municipal offices, prison, and barracks, all being one story high; on the east, the cathedral, dedicated to S. Jago, archiepiscopal palace, and seminario or clerical university; and on the fourth side there is a range of shops: all but the eastern side have an arcade on square piers with a plain parapet. There are also about twenty churches, including that of S. Francesco, which is larger than the cathedral but not so chaste in style, its vaulted roof was cracked and the towers demolished by an earthquake 23 April 1830, that also damaged the churches of Sta. Teresa and of the Recolection; the re-established Dominican convent; six other monastic establishments, converted into barracks; the hospital (the only establishment of the kind in Central America) of S. Juan de Dios, with the contiguous cemetery; the university of S. Carlos; the Tridentine college; a half open theatre; a circus for bull-fights and equitation; an abattoir; and three schools; with four *lavaderos* or public washing places, supplied by an aqueduct six miles in length carried in several places upon fine arches; all these public structures are in a good style, and in some cases well decorated. JUARROS, *History*, 8vo., London, 1823; DUNLOP, *Central America*, 12mo., London, 1847, pp. 94, 291; BAILY, *Central America*, 8vo., London, 1850, p. 50. Views of both cities are given in the ILLUSTRATED LONDON NEWS, 1856, xxix, 155.

The cathedral, dedicated to S. Jago, is described by DUNLOP as wanting its two side towers; as being three-ailed, and about 360 ft. long, with beautifully carved Gothic arches; as presenting a façade of an Ionic order with fluted pillars and a rich cornice; and as being built of a hewn white sandstone. But BAILY notices it as a neat and substantial edifice, having a handsome front and an interior lofty but not grand, with simple and plain attached buildings. The ECCLESIOLOGIST *Journal*, 8vo., London, 1849, ix, 184-5, states "that the cathedral is the only correct and fine church in the country. It was built by an Italian architect in the last century, after the destruction of Old Guatemala by an earthquake. In general correctness of style it is perhaps equal to S. Paul's cathedral, London; and the churches generally are nearly as good as provincial churches in Italy. This cathedral is perhaps about 300 ft. long. A lady chapel east of the high altar has an apsidal end; the nave is about 35 ft. wide and 40 to 45 ft. high, with double aisles each 15 to 20 ft. wide; a north and south clearstory and transepts, or quasi-transepts, with chapels. The walls are of great thickness, and the windows rather small for the size of the building, which has a gloomy appearance. A dome occurs over the choir: the other churches generally have a kind of dome or dome-covered tower; the roofs both of the nave and aisles are plain semicircular stone vaults covered externally with stucco or cement, there being no timber, lead, or slate used. The floors are of stone, and the stalls

and other furniture of good hard wood. The people occupy the whole nave, at the west end of which is placed the organ in a fixed gallery; some chairs and movable benches are used; the Indians squat on the ground. Some of the conventual churches are fully as large as the cathedral, especially those in Old Guatemala. Almost all the private houses and some of the conventual houses have a Moorish appearance, yet none of the churches have this character. Such houses as are not vaulted have their roofs formed of heavy beams, and upon these, thick hard wood planks covered nearly a foot deep with stucco slightly sloped to allow the rain to run off. In Guatemala they have used large masses of stone without bond timbers; Mr. Catherwood thinks if they had adopted a plan similar to that which he observed in Messina, of inserting large timbers in all directions, filled in with masonry, they would not have suffered so much from earthquakes as they have done: perhaps, however, timbers in such a position would be very subject to dry rot and the ravages of wood-ants. In Guiana kyanizing preserves only the outside; a post may look very fair, but will often yield to the pressure of one's finger."

The *BUILDING NEWS Journal*, 1859, v, 302, 310, notices the new theatre (Italian) built of the light volcanic stone of the locality bound with broad horizontal bands of brickwork, the whole set in volcanic lime and pozzolana covered with a thick coating of cement made of the same materials, presenting a marble-like appearance very hard and durable: the cement used in the churches of the old city, built by Alvarado, is still fresh looking and hard, and adherent where untouched by the earthquakes. The interior fittings are made of mahogany and cedar obtained on the coast. 50. 96.

GUATTERIA VIRGATA, formerly *Uvaria lanceolata*, of Cuba and Jamaica, furnishes *Lance wood*, which is imported in long poles 3 to 6 ins. diameter: it is of a paler yellow colour than box and bends easily, and is used for gig shafts and archery bows, for which it is bent by steaming; also for surveyor's rods, billiard cues, and for ordinary rules, though such are described as being of boxwood; HOLTZAPFEL, *Woods*, 8vo., London, 1843, p. 89.

GUAXACA, in Mexico, see OAXACA (SANTA MARIA DE LA VALLE DE).

GUAYANA, in Venezuela, see ANGOSTURA.

GUAYAQUIL. A city situate at the mouth of the river of the same name in Ecuador, in Mexico. It was burnt 1764 and rebuilt 1770. It consisted of two towns, built 1534-5 and 1693, but the timber bridge which separated them has been filled up by houses. The buildings are of wood, including the solidly and recently constructed cathedral, dedicated to S. Pedro, shewn, with the port, in VAILLANT, *Voyage—pendant* 1836-7 (*Album Hist.*) fol., Paris, 1840-6, pl. 39 and 40. Three monastic establishments, a college, an hospital, a custom house, and the larger houses, are respectable specimens of the use of timber; but the church of S. Domingo in the old town was of stone in the time of ULLOA, *Voyage*, 8vo., Lond., 1772, i, 155.

GUAZA (MIGUEL DE) was one of the eight architects whose opinion was taken 1557 on the settlement which had occurred in the cathedral at Seville. 66.

GUAZUMA ULMIFOLIA, see BUBROMA, bastard cedar.

GUBBIO (the Roman Iguvium and Eugubium). A city in the province of Urbino in Italy, having six gates and a still mediæval aspect. The cathedral, dedicated to SS. Mariano and Giacomo, with a front dating about 1450, is supposed to have been the design of G. da Gubbio about 1150-80. There are also seven parish churches, with those of eight monasteries and seven nunneries, especially that of S. Francesco, which externally is in a Pointed style; the palazzo ducale or della corte, now partly destroyed, built about 1450-1500, and ascribed by some authors to F. di Giorgio Martini, but by others to L. Lauranna and B. Pintelli; the magnificent palazzo del comune, which consists of two masses, the palazzo pubblico and the pretorio, connected by arcades, designed 1332-49

by Gattapone; the palazzi with their feudal towers, especially the untouched palazzo Beni, the old palazzo Ranghiasi now the liceo, the modern palazzo Ranghiasi Brancaloni; the theatre built 1727 by M. Lottici and G. Mattioli; the large hospital for the infirm of both sexes 1741-5; and the orphan asylum rebuilt by G. Valadier. The aqueducts are partly carried, it is supposed, upon antique constructions; but the other remains of ancient work are inconsiderable, except an Etruscan tomb about 25 ft. long, 20 ft. wide, and 18 ft. high. Gubbio is celebrated as one of the chief schools for the manufacture of Majolica ware, which is held in such high esteem as an art production.

GUBBIO (GIOVANNI DA) is said to have designed 1140 the duomo at Assisi; 1150-80 the duomo at Gubbio; and 1163 the church of Sta. Maria Maggiore at Assisi. GIANNELLO DI MAFFEO (so called by MORONI), or MATTEO DI GIOVANELLI DA GUBBIO, known as "il Gattapone" according to MURRAY, *Handbook*, designed 1332-49 the splendid palazzo del comune at Gubbio; and at Perugia 1333 the palazzo dei Priori or palazzo comunale; and 1371 the fortress of Porta Sole. 96.

GUCEWICZ (LORENZ), an architect of Poland, was born 1753, and died 1798.

GUDGEON. The term applied to the eye of a hinge. When connected with another term, as 'Band and Gudgeon', it is used in Lancashire for the 'Hook and Band' hinge, as so called in London. GORON.

GUDY. The name given in the Mysorean portion of Hindostan to the temples belonging to the followers of Vishnu as well as to those of Siva, both accepting the Vyasa Veda Puranas as sacred books; BUCHANAN, *Mysore, &c.*, London, 1807, iii, 75, 82, 131.

GUEESH. In Minorca a species of gypsum called gueesh is used, which indurates so very quickly that, in turning arches with it, the use of regular centering is dispensed with, each set of arch-stones being supported by reeds or wooden rods until the keystone is introduced, after which those temporary props, extending throughout the whole width of the arch, are removed and used for supporting another set of arch stones. Thus the arch, which is commenced at one end, is continued in portions, until the whole is completed. In using this cement, the outside joints of adjacent stones being secured with common mortar, the gueesh in powder is stirred up in a bucket with water, until it becomes well mixed but in a fluid state, after which it is poured into all the joints, which are previously scored for the purpose crossways. This cement sets almost instantaneously, and eventually becomes harder than the stone itself, but it must be carefully secured from wet, which renders it useless by reducing it to a pulp. For arches or partition walls protected by a roof nothing can be better; the latter are often built with stones only 3 or 4 ins. thick set on edge, which are sufficiently strong when cemented in the manner that has been described; PASLEY, *Outline of Pract. Arch.*, 4to., lithog., Chatham, 1826, p. 16. It is not stated whether there is any difference between this and the ordinary plaster of Paris.

GUËLMA, a village between Constantina and Bona; see KALAMA.

GUÉMEZ (PEDRO) constructed 1550-1750 two galleries of the cloister of the cathedral at Ciudad Rodrigo, where his bust was placed over one of the doors. 66.

GUENCKEL (FRIEDRICH LUDWIG), was born 1726 at Grofftorf near Giesen in Hesse Darmstadt, and studied at Metz and Paris. He went to the Hague with his patron the prince of Weilburg to build a large hôtel, which was not erected to the extent of the plans, and is now the royal theatre. After returning with the prince to his estates, Guenckel went back to the Hague to finish several other edifices left in progress; many government and private works were then entrusted to him, in some of which he had the cooperation of De Swart and Bergman. He had prepared designs for modernising the Inner-court (Binnen-hof) formerly inhabited by the Stadholders, the

east side of which alone was finished, when in 1795 he was deprived of his government appointments in consequence of his attachment to the house of Orange; but he continued to practise at the Hague until an advanced age. He died in 1818 aged 92. He was one of the masters of J. Bergman, who was afterwards a partner with him. 24.

GUENEPIN (AUGUSTE JEAN MARIE), Hon. and Corr. Member of the Roy. Inst. of British Architects, born 17 June 1780 at Paris, was a pupil of A. F. Peyre, under whom he altered the château de Reuville for the comte de Castellane, and obtained 1806 the *grand prix* by his design for an "établissement de six familles", published by VAUDoyer, *Grands Prix d'Arch.*, fol., Paris, 1811, pl. 119-20. During his residence in Italy he specially studied the buildings by G. Barozzi, and took, as his subject for restoration, the arch of Titus. The favourable opinion expressed by the academy upon the drawings made by him of that monument are quoted in the memoirs by his pupil THUMKLOUP, given in DALY, *Revue Générale*, 4to., Paris, 1843, iii, 74, and by another pupil, LEQUEUX, *Notice*, 8vo., Paris, 1842: from which accounts the whole course of his posts and associations not here noticed may be learnt. He returned 1810 to Paris; was made 1811 sub-inspector of the works at the abattoir of Montmartre; took 1817-22 the management of Huyot's school and office while his friend travelled (altering the house of Huyot's client M. Debaux in the rue des Saints Pères); and was named 1820 inspector to the works of underpinning and restoring the church of S. Germain-des-Prés, and of constructing the séminaire S. Sulpice. But the most important employment obtained by Guenepin was 1824 that of architect to the arrondissement of S. Denis (department of the Seine), for which he designed several *maisons communales*, cemeteries, and churches; GOURLIER, *Choix d'édifices*, fol., Paris, 1825-50, i, 1, gives the church erected 1824 at Noisy-le-Sec, costing 45,000 francs; and ii, 278, the chapel erected 1830-32 in the Ile S. Denis, costing 15,000 francs. He resigned 1830 this post in favour of Lequeux, and 1833 was elected into the Académie des Beaux Arts, in consequence of the prizes that had been gained by his pupils, who are supposed to have carried off more than a hundred, and to have been nearly two hundred in number: indeed in 1834 the whole of the four great prizes were taken by his pupils, and 1835 this was acknowledged by the cross of the Légion d'Honneur. During a visit to England he made studies of the architectural fragments in the British Museum. The high altar of the church of S. Thomas d'Aquin at Paris was executed, with some variations, from his design; and when the château and estate of Belle Vue near Paris were divided into private residences, he designed several and was consulted upon others. He made projets for an abattoir at S. Denis and at Saumur, and for the church of N. D. de Lorette at Paris. He died 5 March 1842. GABET, *Dict. des Artistes*, 8vo., Paris, 1831, and others, give the name as Jean Marie Auguste Guenepin.

GUEPIERE, GUESPIERE, or GUIPIERE, are some of the various forms in which the name of an architect elected 1720 into the Academy of Architecture at Paris have been written; but the autograph LOUIS PHILIPPE DE LA GUÉPIERE appears on pl. 4 of the *Recueil d'Esquisses d'Architecture*, etc.—*dont une partie sont construits par le Sieur De La Guépiere*, major d'artillerie et directeur-général des Bâtimens et Jardins de S. A. S. M. le duc de Wurtemberg, etc.—membre des Académies de Rome, Impériale d'Augsbourg, et de Berlin, fol., Stuttgart, 1750, in which, after announcing that he has included the plans, etc., of the palace then under his charge at Stuttgart, showing this building commenced upon the designs of several architects, the immense changes that he had made in the distribution, the restorations of the parts previously built, the left wing with the staircases, all executed by him; and proposing to publish another work that would exhibit the interior decorations of the palace with other designs, such as pavilions, belvederes à la Chinoise at Louisbourg, arrangements at fêtes,

the theatre at Stuttgart and at Louisbourg, and designs for several German sovereigns, princes, and nobles, the greater part of which were executed, he submits for criticism thirty plates of careful sketches of architectural designs cleverly engraved by himself, and eighteen plates illustrating the palace, preceded by a portrait of the author and the inscription P. L. Philippes Delaguépiere. He was still at Stuttgart in 1767; but BLONDEL, *Cours*, 8vo., Paris, 1773, iv, 150, mentions the kitchen offices 'by the late M. de la Guipiere' at the château de Bercy. R. F. H. Fischer was his pupil.

GUERCHY (MARQUIS DE), see RÉGNIER (LOUIS DE).

GUERINI or GUERRINI (ROCCO), generally known as the graf Rochus von Lynar, born 25 December 1525 at Marradi in Tuscany, obtained 1542 military employment in France; entered 1569 the Saxon army as ober-artillerie-meister; and 1578 the service of the elector of Brandenburg with, besides pensions from other states, a salary of 1000 rixdollars and allowances, of which a long list is given in the memoir published by NICOLAI, *Beschreibung*, 8vo., Berlin, 1786, app., 23. He became general and baumeister, with a yearly salary of 1200 rixdollars and a grant of 3000 more annually for ten years, apparently made for the purpose of enabling him to build his palatial mansion at Spandau. He was consulted 1582 about the fall of the tower of the Katharinenkirche at Brandenburg; and designed 1594 the five-storied building which separates the courtyards of the *schloss* at Berlin. He died 22 December 1596 at Spandau. RAMPOLDI, *Corog.*, s. v. Marradi, calls him GUARINI.

GUERRA. The family name of three brothers, two of whom practised as architects. The youngest, GIAMBATTISTA, was a priest in the oratory of S. Filippo Neri, and superintended for him about 1575 the erection at Rome of the church of Sta. Maria della Vallicella and S. Gregorio from the design of M. Lughini, and of its façade from the design of F. Rughesi. GASPARO made 1599 five designs for the cathedral which was soon afterwards erected by him with half its façade, at Ripatransone; the cupola by F. Rossetti was added about 1770, and the front was completed upon another design about 1810; GUALANDI, *Memorie*, 8vo., Bologna, 1844, iv, 123-5. Being engaged for several religious establishments at Rome, he designed about 1612 for the PP. Minimi, besides part of their monastery, the church of S. Andrea della Fratte, to which the cupola and campanile were added by Borromini and M. de' Rossi, but the façade 1826 by Valadier. This church is ascribed by GWILT, *Notitia*, 8vo., London, 1818, p. 122, to a *Francesco*, and p. 94 to a *Giovanni GUERRA*, and the latter error is repeated in the NOUV. BIOG. GÉN., 1858, s. v.

GIOVANNI, the eldest, born 1544 at Modena, settled 1562 at Rome, where he is said to have made a design for the Scala Santa. Besides the church of Sta. Maria di Paradiso, commenced 1596, and that of the Madonna delle Asse, PAGANI, *Pittura*, Modena, 1770, ascribes to him that of S. Agostino in that city: but the latter, built 1245, was not restored until 1662 according to GUALANDI, i, 119, 113; vi, 197. He died 29 April 1618 at Rome, aged 78 years according to BAGLIONI, 38. 93. 96. 111.

GUEST HOUSE, see HOSPITIUM.

GUETTARDA SPECIOSA. A native tree of Jamaica in the West Indies producing one kind of Pidgeon wood, also called Zebra wood: it is brought over in small planks; its colour is intermediate between those of mahogany and rosewood, but the variegations are less dark and more wavy than in the latter. It is much valued for the finer kinds of furniture. Tortoise wood is probably a variety of the same species; ARCHER, *Pop. Econ. Botany*, 8vo., London 1853, 338.

GUEULE, GULA or GOLA; see CYMATIUM.

GUEVER, see GEYER.

GUGELIN (HANS) was 1492 *baumeister* of the münster at Ulm. 92.

GUGLIELMELLI (ARCANGELO) designed the chapel on

the epistle side of the church of the nunnery of S. Giuseppe de' Ruffi; the church of the nunnery of Sta. Maria del Gesù; and about 1670 the church of the Rosario al Largo delle Pigne, besides modernizing, if not rebuilding, the church of S. Angelo a Nido, all at Naples. 95.

GUGLIELMELLI (MARCELLO) executed from the drawings of B. Picchiatti the atrium and majestic stairs of the church of Sta. Maria Egiziaca or di Pizzofalcone; and from his own designs erected the atrium and front of the church of the nunnery of S. Giuseppe de' Ruffi; and the library of the RR. PP. dell' Oratorio called the Gelormini; all at Naples. 95.

GUGLIELMO DA PISA (AGNELLI), see AGNELLI (G.).
GUGLIELMO TEDESCO, see INNSBRUCK (WILHELM von).

GUIANA WOOD, see KING WOOD.

GUICHARD (ANTOINE) finished 1497-1529 the church of Notre Dame de l'Épine near Châlons-sur-Marne which had been commenced 1400-29 by Patrice or Patricius, an Englishman, BAUGIER, *Mem. Hist. de Champagne*, 8vo., Paris, 1721, i, 270-4; COMITÉ HISTORIQUE DES ARTS, etc., *Bulletin*, 8vo., Paris, 1843, ii, 245; after the fashion of the cathedral at Cologne according to BOISSERÉE, *Histoire*, 4to., Munich, 1843, p. 24.

GUIDE. The groove for the patent rolling shutter blinds; and also (Fr. *tringle*) the groove or tram placed under or above the wheels or rollers or balls of sliding doors, shutters, and blinds.

GUIDETTI (ANTONIO), modernized 1715 the church of Sta. Maria a Colonna at Naples. 95.

GUIDETTO, according to the inscription on one of the columns "Mill cc iiii condidit electi tam pulcras dextra Guidetti," executed the façade of the cathedral church of S. Martino at Lucca, which was rebuilt 1160 according to the local *guide books*, as stated in the notes to VASARI, *Vite*, 12mo., Florence, 1857, i, 211; but 1060 in the NOUV. BIOG. GEN., 1858, s. n., which adds that 1203 he designed the front and sculptured the architrave of the church of S. Pietro-Somaldi. GALLY KNIGHT, *Eccles. Arch. of Italy*, fol., London, 1842-4, ii, pl. 14, shows the west end of the church of S. Michele in the same city, which he says was also executed 1188 (WEBB, *Sketches*, 8vo., London, 1848, p. 396, gives 1070) by Guidetto.

GUIDI (GIACOPO DI PIETRO), although invited from Florence to take the place of Peter the son of John of Freiburg as capo-maestro to the duomo at Orvieto, seems only to have been engaged 1402-5 on the font, though 1407 Sano di Matteo put his own name on the cover. 67.

GUIDO (ANTONIO DI SER) of Siena was maestro de' maestri (i. e. architect) to the duomo at Orvieto 1337, and was employed there at least until 1359, although M. Nuti seems to have superseded him in 1350. 67.

GUIDO (MANOEL CAETANO) of Lisbon was engaged 1827 on the palace of the Ajuda. 68.

GUIDOTTI (PAOLO) a painter and sculptor of Lucca, born 1569, is stated by MILIZIA, who gives a long account of his talents, to "have been also considered a good architect. He was commissioned to make the magnificent preparations in the Vatican in 1622, for the canonisation of the four saints, Isidoro Ignazio, Francesco Saverio, Filippo Neri, and Teresa. We are not acquainted with any other of his architectural works." He died in 1629. 3.

GUIERA. The modern village on the site of APHRODISIAS in Asia Minor.

GUILD, GUILD CHAPEL, GUILD HALL, GUILD HOUSE. The term 'guild', derived from the Saxon *gildan*, 'to pay' or 'to contribute', was the term in England for a company of lay persons that raised funds for the purpose of mutual relief or of mutual defence, or with the two objects combined.

Considering the subject from the first, or religious, point of view, the term is still the proper designation of an association of Roman Catholic lay persons established, in some

church or other oratory, or having an oratory or chapel of its own, in honour of a doctrinal mystery or a saint, as well as for the exercise of religious and pious works, such as the attendance at divine worship, at the funerals of members, the visitation and education of the poor, etc. Such a body is also called in Italy *congregazione, società, compagnia, scuola*, etc.: and if entitled to affiliate others, it is termed an *arciconfraternità*. The members have statutes, carry the banners, and wear the uniform peculiar to each body: they frequently possess a burial ground; and have caused the erection for their establishments of some of the handsomest buildings on the continent, which receive the names peculiar to each individual association; FARUCCI, *Trattato di tutte l'opere pie*, 8vo., Rome, 1601. Such associations existed in England before the Conquest (EDEN, *State of the Poor*, 4to., London, 1797, i, 590-8), and increased so rapidly that legislative measures became necessary in the reign of Edward III, to regulate and restrain them: indeed certified returns were required to be made of their rules, and of the extent of their possessions; and letters-patent seem to have been necessary in the foundation 1340 of the celebrated guild of S. Mary at Coventry, and in subsequent cases. PARKER, *Dom. Arch.*, 8vo., Oxford, 1853, ii, 177, states that there was one in almost every parish and village, the hall being generally a timber building near the church, and sometimes over the lychgate; and he cites BLOMEFIELD, *Hist. of Norfolk*, fol., Lynn, 1769, iii, 494, as mentioning that "the house on the south side of the churchyard of Oxburgh belonged to one of the guilds there, and is called in old writings the gildhall" (of the Trinity or else of S. Thomas); "and the house on the east side of the said churchyard was another gildhall, and belonged to that of Corpus Christi."

Considering the subject from the second, or secular, point of view, the term was the early English designation (afterwards changed to Livery Company) of an association of persons engaged in trade, which is described in the later licences for foundation as a brotherhood or guild of the mystery (It. *mestiere*, Fr. *métier*, a trade), whose master and wardens were to oversee, search, rule, and govern the commonalty and mystery and all men occupying the same, with their servants, stuffs, works, and merchandizes. Such guilds, like that called the Academy of S. Luke at Florence, combined much of the religious nature above described with the secular occupation of watching over the tuition of apprentices, the exclusion from employment of workmen or tradesmen that were foreigners (i. e. native or foreign persons not possessed of the freedom of the town), and the quality and prices of the materials and workmanship vended by the members. Their treasuries were soon found to be available for the speedy collection of assessments and loans, and so the guilds secured the registration of every freeman in some guild, and became therefore (as in London 1375-6) the constituents of the corporation to an extent that may be studied in SHEPPARD, *Corporations, Fraternities, and Guilds*, 8vo., London, 1659. Thus, although the wealthier guilds had each (if not a private chapel, at least) a chantry in a neighbouring church, and a hall for the transaction of its special business (such as the hall of the merchants or guild of S. Mary [popularly called John of Gaunt's stables] at Lincoln, TURNER, *Dom. Arch.*, 8vo., Oxford, 1851, i, 40), the town frequently possessed a hall for the use of the companies when assisting in the municipal government, or transacting public business (such as the Guildhall in King-street, London), so that it became in fact the TOWN-HALL.

It is stated that in the Low Countries each guild or similar confraternity had charge of the military defence of certain parts of the town walls; a custom which seems to have been universal in the privileged towns of the mediæval period, and to be exemplified in Michael of Kildare's poem on the erection of the walls of New Ross in the county of Wexford, given in the ARCHÆOLOGIA, 1829, xxii, 307-22; 1840, xxviii, 438-41; for the translation of 'purveance' as 'byelaw' therein seems

directly opposite to the intention of the original 'purveyance' or 'provision'. Contributing not only funds for the honour and support of their respective trades, but also for devotional and charitable purposes, such as masses for the dead and decent funerals for the poorer members, and at a later period loans and almshouses, these guilds resembled in a great degree at once the trades unions and the benefit societies of modern times. HERBERT, *History of the twelve great Companies of London*, 8vo., London, 1837, and JEFF, *History of the Company of Carpenters*, 8vo., London, 1848, will be found to illustrate fully the character of such guilds. VIGNE, *Recherches Historiques sur les Costumes—des Gildes*, etc., 8vo., Gand, 1847-57. The Dean of Guild is in Scotland still held an important officer; at Glasgow, for example, holding a court having authority over the erection and alteration of all buildings; PENNY CYCLOPÆDIA, s. v.

GUILHELMUS was introduced at Avignon probably about 1323 to John IV bishop of Prague, who, because there was no architect in Bohemia or in neighbouring countries capable of building a bridge over the Elbe, invited this 'Guilhaume' with three companions to Prague. They laid on S. Bartholomew's day 1333 the first stone of the bridge at Raudnitz, built two piers with an arch and returned 1334 to France, the work being afterwards completed by the native artificers whom they had instructed; FRANCISCUS, *Chronicon*, in PETZEL AND DOBROWSKY, *Scriptores Rerum Bohemicarum*, Prague, 1783, ii, 108. NAGLER, *Lex.*, s. v. Guglielmo, calls him an inhabitant of Rome; and s. v. Wilhelm von Avignon, adds that he designed the monastery at Raudnitz; FRANCISCUS merely says that the bishop built it. 20.

GUILHERME (. . . .), master of the works at the Batalha, succeeded F. d'Evora at his death 1473-7. He is called GUILLAUME, in RACZINSKI, s. v. Evora.

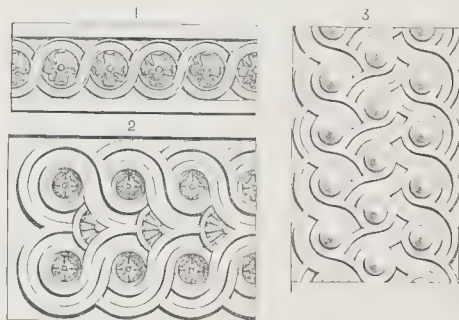
GUILL (MATEO), was born 1753 at Fuente del Fresno in Spain; became 7 November 1779 member of the academy of S. Fernando; and died 29 September 1790 being then assistant architect to the town of Madrid. 66.

GUILLAUMOT (CHARLES AXEL, called ALEXANDRE by QUERARD) born 1730 at Stockholm of French parents, studied at Hamburgh, and 1745 at Paris, where he was considered a foreigner and not allowed to compete for the academical prizes. In 1750, however, he obtained the first premium and went to Rome; afterwards visited England; and tried to establish himself in Spain by becoming an officer in the Walloon guards. He returned 1754 to Paris, and was immediately employed to design and construct the barracks at S. Denis, at Ruel, and at Courbevoie; was appointed 1761 ingénieur-en-chef de la généralité de Paris, as successor to his father-in-law Le Blanc; built 1770 the barrack at Joigny; was elected 1773 into the Academy of Architecture; became 1777 directeur des carrières and contrôleur des bâtiments du roi; was named 1780 successor to Soufflot as intendant-général; 1789 directeur des Gobelins, and was promised the reversion of the post of premier-architecte held by Mique. He designed the abbatial palace at Vezelay, the château de la Brosse near Montereau, and the château de Sauvigny. He published *Remarques sur un lièvre* (by the abbé LAUGIER) intitulé 'Observations sur l'architecture', 8vo., 1767; *Mémoire sur la manière d'éclairer la galerie du Louvre*, 8vo., 1797; *Considérations sur l'état des beaux arts à Paris, particulièrement sur l'architecture et sur la nécessité d'y élever plusieurs monuments importants*, 8vo., 1802; *Essai sur les moyens de déterminer ce qui constitue la beauté essentielle dans l'architecture*, 8vo., 1802; *Considérations sur les connoissances et les qualités nécessaires à un architecte pour exercer son art avec distinction*, 8vo.; *Observations sur le tort que font à l'architecture les déclamations hasardées et exagérées contre la dépense qu'occasionne la construction des monuments publics*, 8vo.; and several reports upon the quarries under Paris; upon the manufactory at the Gobelins, etc. He died 7 October 1807. 113.

GUILLEN (PEDRO) of Esi-Huda, undertook with M. Real at the death 1630 of M. de Ueeta the completion of the important collegiate church of S. Nicolas at Alicante; and died 17 February 1658. 66.

GUILLOT (AUBREY), built about 1720 the hôtel de Villeroy, altered about 1746 by Le Roux, in the rue de Varennes at Paris; where he also erected the hôtel de la Vrillière forming great part of the hôtel de Conty, altered after 1732 by Simonet, in the rue S. Dominique. All these works are given in BLONDEL, *Arch. Franç.*, fol., Paris, 1752-6, i, 212 and 238. He also built the hôtel de Bouillon on the quai des Théatins; became 1737 a member of the Academy of Architecture; and finished 1740 the Chambre des Comptes. He appears to have been one of the artists who submitted 1748 plans for a *place Louis XV*, and his design is given in PATTE, *Monuments*, fol., Paris, 1767, pl. 49-50, who calls him Aubri, architecte du roi. He died in 1771.

GUILLOCHE (Ger. *kettenzug*), corrupted in England to galloche and galosh. The word (assumed by BRITTON, *Dict.* s. v., to be derived from *γυῖον*, a member or a limb, and *λόχος*, a snare or a troop in ambuscade) that has become the technical English designation of the ornament which consists of a number of equidistant circular spaces all of one diameter surrounded by a single or double fillet and generally decorated with small flowers. This seems to be the Fr. *entrelas*. HOPFUS, *Gentleman's Repository*, 4to., London, 1748, p. 80, pl. 63-4, uses the words fret and guilochi indifferently for a fret, for a diamond chequer, and for the single, double, and treble guiloches here illustrated; Fig. 3 being from the capital of the Ionic columns of the tetrastyle portico of the triple temple at Athens, as given in colours in the *Transactions of the Royal Inst. of British Architects*, 4to., London, 1842, i, pt. 2.



The guiloches, as the term is now used, is at least as early as the sculptures at Nimroud; and it also occurs at Jackly, as well as in the temple to Nemesis at Rhamnus, given respectively by the DILETTANTI SOCIETY, *Ionian Antiq.*, fol., London, 1767, i; and *Unedited Antiq. of Attica*, fol., London, 1817; another example is to be found in CANINA, *Ant. Etr. Marit.*, fol., Roma, 1849, pl. 57, in an ornament from Cære. Mæanders are meant by the reference which QUATREMÈRE makes to the soffit of the architrave of the temple to Mars Ultor, and to the work by Peruzzi in the palazzo Massimi at Rome. But single guiloches occur in the soffit of the architrave of the temple to Antoninus and Faustina, TAYLOR and CRESY, *Antiq. of Rome*, fol., London, 1821, i, pl. 65; and Peruzzi introduced single and double guiloches in several portions of the palazzo Pietro-Massimi at Rome, LETAROUILLY, *Edifices*, fol., Paris, 1825, pl. 281-97; who, pl. 260, shows that they had been employed earlier by Pintelli at the ospedale di S. Spirito. The word is spelt *guilochis* by French authors, who use it only in the plural, such as AVILER, *Dict.* s. v., and VIRLOYS, *Dict.* s. v., pl. xxv, fig. 16-21, but their explanations as amplified by QUATREMÈRE DE QUINCY, *Dict.* s. v., indicate the ornaments better known in England as FRETS, but properly MÆANDERS;

indeed, the latter author adds that they are also called *bâtons rompus* and *méandres*: for although they have spoken of single and double filleted frets and then of *guillochis à entrelas*, and of the rosettes or buds which decorate the centres of the revolutions, they do not seem to have any peculiar term for the ornaments shown in the illustrations above given. And although CHAMBERS, *Treatise*, etc., fol., London, 1759 (Ceilings, pl. 2), gives examples of 'frets or guillochis of various sorts' including the guiloché as now understood, it is curious that, like TAYLOR as above noted, INWOOD, *Erechtheion*, fol., London, 1827, pp. 17, 139, referring to the ornament, uses no distinctive name for it. As the word occurs so early as 1666-7 in the shape of 'gollosse', in the 'Accounts of Works' done for the king, Harl. MS., 1658, noticed in the *BUILDER Journal*, xii, 567, it is safe to conclude that it was not, as has been supposed, derived from the historical painter Louis Galloche, who died 1761 at Paris aged 90.

GUIMARD (. . . .) was extensively engaged 1765-86 at Bruxelles, where he formed 1774 the *parc* in the modern portion of the town; and built the *place royale* with its eight blocks of buildings, reproducing the arrangement of the *place royale* at Reims; commenced 1776 the church of S. Jacques sur Coudenberg, finished 1785 by Montoyer; built 24 August 1779-83 the *palais de la Nation*, or of the States-General; and the great fountain in the rue Haute. He designed the château, built 1786, at Wanneghem, near Oudenaarde, and some châteaux near Laeken. He is called Guimart in the COMMISSION ROYALE D'HISTOIRE, *Bulletin*, 8vo., Brussels, 1848, xiv, 531; and Guymard in WALTERS, *Brussels*, etc., 8vo., Brux., 1855, pp. 43, 51, 61. GOETHEBUER, *Choix de Monumens*, fol., Ghent, 1827, pl. 8, gives the church of S. Jacques, which he says had its plan arranged by the elder Payen, who finished the works 1785; pl. 23, the palais des Etats-generaux, restored by Van der Straeten; pl. 27-9, the house at Wanneghem; and states that he died about 1792 in the environs of Paris. 101.

GUINAMAND, a monk in the abbaye de La Chaise-Dieu, worked 1077-82 the tombeau de S. Front, in the cathedral at Périgueux. DE MONTAIGLON AND GUIGNE, *Arch. de l'Art Franç.*, vij., 30. 112.

GUINGUAMPS (JUAN DE) of Narbonne, was one of the eleven architects whose opinion was taken 23 January 1416 upon the course to be adopted in the erection of the cathedral at Gerona. 66.

GUINGUETTE. The name given in France to a suburban garden to which persons resort on Sundays and holidays to regale themselves free of the *octroi*. When an orchestra and a floor or room for dancing are added to its other attractions, it is called a *bastringue*.

GUIOT DE DAMPMARTIN (. . . .), general master of the works of the duke of Berry and of Auvergne, comte de Poitou, built the *grosse horloge* at Poitiers 1385-90; COMITÉ HISTORIQUE, *Bulletin*, 8vo., Paris, 1842-3, ii, 464. He is probably of the same family as DROUHET DE DAMPMARTIN.

GIUSSANO (G. DA), see GIUSSANI (M.)

GUITTI (FRANCESCO) erected 1624 the church of Sta. Maria della Rosa at Ferrara.

GUJA or GUJAH. The measure of length introduced into Hindostan by Tippoo was founded on the gujah, equal to 38½ inches English.

6,000 gujahs = 1 hardary, commonly called by Europeans a sultany coss, = 3 miles 5-16 furlongs.

4 hardaries = 1 gavada or day's journey = 14 miles 4-64 furlongs.

But the hardary in common use is one-fourth less, and = 2 miles 5-87 furlongs; so the gavada = 10 miles 7-48 furlongs.

This measurement is called *canter'raia*, or cantery as the English pronounce it; BUCHANAN, *Mysore*, etc., 4to., London, 1807, i, 131.

It is stated s. v. COLAGA to be 37½ ins. English.

GUL, PHOOL, KUTAFIA. Terms used in Hindostan for spandril ornaments over openings, as roses or foliage; KITTOE, *Illustrations*, etc., fol., Calcutta, 1838.

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GULA; see CYMATIUM and GORGERIN. The upper portion of the cyma recta is the Fr. *gueule* or *gueule droite* according to QUATREMÈRE, *Dict. s. v.*, who says that the lower or convex portion is the *gueule renversée*: other French authors term the whole molding *cimaïse*, *doucine*, *gorge*, and *gueule*. NEVE, *Dict.*, 1736, s. v. however says that gula means the neck or narrower part of a pillar: also the wavy member, whose contour resembles the letter S, called an ogee: and sometimes the entablature, of which it is the uppermost member.

GULDAR, GULZAR, KINGRA, KUNGURA, KUTHERA, KUTERA. Terms used in Hindostan for ornamental balustrades and parapets; KITTOE, *Indian Architecture*, fol., Calcutta, 1838.

GULDE (ALEXANDER), *customarius burgi de Striveline* (Stirling), was master of the works of the castle in 1429 and 1434; BANNATYNE CLUB, *Comput. Camerar. Scot.*, 4to., Edinburgh, 1847, iii, 186, 219, 221; and ROBERTSON in *Trans. of Arch. Institute of Scotland*, 8vo., Edinb., 1851, i, 57.

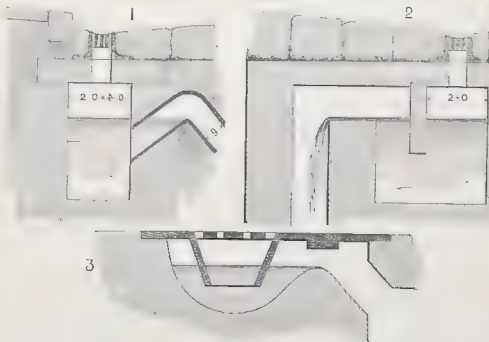
GULDISTA. A term used in Hindostan for a pinnacle; KITTOE, *Indian Architecture*, fol., Calcutta, 1838.

GULIELMUS ANGLUS, see WILLIAM THE ENGLISHMAN.

GULLET or GALLEY. A chip of stone knocked off by the mallet and chisel while working a face.

GULLY HOLE (probably corrupted from "gullet hole," because it sucks down the fluids and other substances which come in contact with it; A. A.). A hole formed immediately over a trap, head, or other entrance to a pipe down to a drain: it must be made large enough to receive all the water that may be conducted to it, and to retain all the impurities which find their way into it. Generally speaking the gully holes of drains are trapped, as is the case with the gullies of the London streets; and they are made deeper than the outlet in order to allow the foul and heavy matter carried into the drains to accumulate in such positions as to be easily removed. COCKADE; FLAP.

Gully holes are usually executed in the line of the gutters of streets, at the side of the foot-path. They are generally formed of a cast-iron grating, that is hinged to a cast-iron frame, let into brickwork built in cement, at the level necessary to admit the paving stones of the gutter; this brickwork is usually the arched top of a square receptacle, that is intended to receive the deposit which the roadway may furnish with the water that runs off from it. Consequently, the dimensions of the receptacle are made sufficiently large to allow the accumulation to take place, and the escape of the supernatant fluid is effected by means of a chamber that is separated from the inlet by a stone that dips down into the water at the bottom of the gully hole, or by means of a syphon tube that discharges the water only above the bend. Fig. 1 represents



the gully hole used in Liverpool, in which the grating is about 1 ft. 2 ins. long by 8 ins. wide, and the syphon with the upper lip, at about 2 ft. from the surface of the gutter. In London the traps are more generally formed with a stone, in

the manner shown in fig. 2; the object to be gained being, in both cases, to interpose a substance that is impermeable to smell; this is effected by closely fitting the top of the stone, or the syphon, in the brickwork, and making it dip into the water, at the bottom, about 3 ins. The mud and filth are deposited at the bottom, and do not pass over with the water; as soon as the mud accumulates to the height of the overflow, it becomes necessary to clean it out. Great precautions are required to secure the constant presence of water in these, as well as in all other kinds of traps, for in warm weather the evaporation may take place with sufficient rapidity to leave the outlet of the syphon dry, in which case the smell will return and escape through the grating, as is the case with the trap (fig. 3) employed in the French *abattoirs*, which holds but little water, and is therefore soon unserviceable.

G. R. B.

GUM. This term is properly applied only to those natural concrete exudations which, when solidified by drying, are capable of being redissolved by water. They are often transparent and are more or less coloured, the tint varying from white to reddish brown. When insoluble in water, but soluble in alcohol, they bear the name of gum resins; and if soluble in oil or spirit of turpentine, resins. Besides these there is the gum elastic, indiarubber (*CAOUTCHOUC*); and the anomalous product, *GUTTA PERCHA*. The true gums are restricted to gum arabic, senegal, and tragacanth. The gum resins and resins comprise dragon's blood; copal; gum mastic; gum sandarach; turpentine; tar and its distillation pitch; asphalte, a fossil pitch; indiarubber; and gutta percha; *ARCHER, Pop. Econ. Botany*, 8vo., London, 1853, 239-58.

GUMIEL (PEDRO DE) called Gamiel by *STUART* and by *GWILT* (who with *MILIZIA* attribute to him the Hieronymite monastery of Sta. Engracia, built about 1476-1517 at Saragossa, whose architect was not known to *LLAUNO*), was born at Alcalá de Henares, and, as architect to the cardinal Jimenez de Cisneros, executed many works in that city: amongst them were the church of SS. Justo y Pastor, a three-ailed edifice, built 1497-1509, and the college of S. Ildefonso, commenced 14 March 1498, with a foundation stone which commemorated the cardinal and the architect: the latter building was of *tapia*, but afterwards the society rebuilt it of stone, and the façade is the design of R. G. de Hontannon 1541-53. He was sent 1500 with H. de Egas to arrange the works intended by the cardinal for the capilla mayor of the cathedral at Toledo, and probably died 1515-7; the date does not appear in the inscription "*Petrus Gomelius Complutensis Academiae Architectus Card. Hisp. Fundatoris Permissu Sibi et Suis V. F.*", in the chapel of the college: and his name in the account books of that institution is generally accompanied with the epithet *el honrado*, which also was affixed to the retablo with his portrait given 1492 by him to the hermitage of Veracruz at Alcalá la Vieja. 66.

GUMPP (CHRISTOPH) was hofbaumeister and kammerrath at Innsbruck, where he built about 1650-60 a turnier-haus or carrousel 500 ft. in length; and died 1672. 26. 68.

GUMPP (GEORG ANTON), born 1670 at Innsbruck, studied in Italy, and on his return designed in the capacity of hofbaumeister the landhaus, the gymnasium, the spital-kirche, and the S. Jacobs-pfarrkirche in his native town, where he died 1730. 26. 68.

GUM TREE. The name given to various trees employed for timber and other purposes:

| | |
|----------------------------|---------------------------------|
| Blue and Red and York gum, | see <i>EUCALYPTUS</i> . |
| Black and Sour | ditto, see <i>NYSSA</i> . |
| Sweet | ditto, see <i>LIQUIDAMBAR</i> . |

Gum, blue, white, or red, is nearly the universal timber used at Melbourne, in Australia; it has the peculiarity of being heavier than water, and of shrinking horizontally to a considerable extent. Blue gum from Van Diemen's Land, and Kaurie pine from New Zealand, are far better timber; *BUILDER Journal*, xv, 564. In a gorge on the declivity of the Mount Wellington range, near Tolossa, about six miles from Hobart

Town, a tree of blue gum species was found to be twenty-eight yards in circumference (more than 27 ft. in diameter): *Proceedings* of the Royal Society of Van Diemen's Land, 1863.

GUNDULPHUS or GUNDULF. An eminent ecclesiastic of the eleventh century, who has for some years been termed an architect of much note. Indeed, he is stated by some writers to have originated great and important changes in the architecture of his time. His biography was written by a contemporary hand (*MS. Cott., Nero, A, viii, 39*, printed in *WHARTON, Anglia Sacra*, fol., London, 1691, ii, 273), a monk, who states in his *prologus*, that he has related nothing but those things of which he himself was an eye-witness, or had received from credible persons who were so. Gundulf was born "in territorio Vilcasino" in the diocese of Rouen, about 1022; studied grammar at the college in that city; entered into holy orders, and was a *clericus* in the church of the Virgin in that place, where he attracted the notice of William the archdeacon, who introduced him to the archbishop Maurilius, and he accompanied the former in the usual pilgrimage to the East. On his return about 1057 he took the vows as a monk in the abbey of Bec; was soon afterwards custos and sacrist; and a particular friend of Anselm who became archbishop of Canterbury, as well as of Lanfranc (his successor) whom he accompanied to the abbey at Caen, and by whose good offices Gundulf was ultimately elevated to the see of Rochester 19 March 1077. It was after this period that his first building operations were commenced. The cathedral at Rochester being "almost destroyed by old age, he built it anew as it appears at this day" (*Cott. MS. Vesp., A, xxii, 122 b*, in *WHARTON*, i, 338). He is also stated to have built the abbey at Malling; the leper hospital of S. Bartholomew at Chatham; the churches of Dartford and Darenth, all in Kent; with several others of less note; and also the original Norman choir at Canterbury, which was afterwards pulled down to make room for "the glorious choir" of Conrad. The latter buildings are only known as his work traditionally; of the erection of the former there are records. He was not only the *builder* (in whatever sense the word may be taken) of churches, an occupation consonant with his profession as an ecclesiastic, but he is said to have *built* castles; the celebrated White Tower of London for William I; the great Norman keep at Rochester; and perhaps others. The former building is only noticed in connection with his name, in the *Textus Roffensis*, printed by *HEARNE*, 8vo., London, 1720, by the words "*ex præcepto regis Willelmi magni, præset operi magnæ turris Londoniæ*"; and of the latter building (at least it is supposed to be that building) there is a long and circumstantial account in the *Textus Roffensis*, and in the *Anglia Sacra*, that it was erected for William Rufus, as a sort of fine, or compliment for the restitution of the manor of Hadenham, which had fallen into the hands of that monarch, and that the cost of the castle was estimated at sixty pounds. It has been doubted, however, how the phrase "*ædificavit*" ought to be understood. Some believe that Gundulf was the *designer*, the actual *architect* of these buildings; while others think that he merely was the patron finding the money, employing master masons and workmen, supervising the expenditure, and no more a practical architect than were Chicheley or Wolsey, though they are said by their biographers to have "built" largely.

Now, it seems very curious that, at the same time when the doubts above stated are raised, another body of antiquaries, who believe that Gundulf really *was* an architect, detract from his fame by statements that, after all, his executed works were of the smallest kind. One able authority is reported to have stated that Gundulf built the crypt of the cathedral at Rochester, "but certainly not another stone, except perhaps the transeptal tower." Another says that he merely began to build the keep at Rochester; only a small portion of the White Tower; and also only a part of Malling abbey. The principal reasons adduced for these assertions are, that the style is later,

"of a more refined and advanced character than Gundulf's time", and, in particular as to the keep, that he may have begun it and laid out £60 on it, but that this sum was so totally inadequate to finish such a work, that it must have been completed by other hands. The reply has been, that the clear and positive authority of two of the best chroniclers, is not only that Gundulf built the cathedral at Rochester, but (in two places it is recorded) that he finished it; that Edward de Hadenham (WHARTON, i, 362) gives a very careful chronicle of the works of subsequent bishops; and it is asked whether it be possible that whilst recording the building of the offices, he should forget the cathedral itself? As to the advanced character of the style, it is replied that it is incorrect to consider Gundulf's time as that of Early Norman exclusively; that he was, in fact, not one of the early bishops created by the Conqueror, being not made so till eleven years after that monarch came into England; that he held the see of Rochester nearly a third of a century, extending seven years into the reign of Henry I. It is also urged that styles grow by degrees, and that as Lincoln was probably the cradle both of the Early English and Decorated styles, and Gloucester of the Perpendicular, so Rochester in all probability was the place where the more advanced and richer Norman first had its origin and chief impetus. As to the sixty pounds, the account is circumstantial; but this means not £60 sterling, but sixty pounds weight of coined money, according to the reckoning of the time; and considering the timber, stone, lime, and tiles, with the labour of vassals and pressed workmen, to have been, as then usual, supplied to him; and, taking the value of money at about sixty times more than it is now, that amount will not be found so much out of the way.

Indeed, the supposition of his being a designer or a practical architect, rests on one single sentence in the *Textus Roffensis*, which states that he was "in opere cementarii plurimum sciens et efficax", which may mean that he knew when work was well done, and the way to get it done, but no more. It nowhere appears in his biographies that he had learnt anything of architecture during his early travels, or gave any attention to it during his studies, or even to its cognate branch, mathematics, as William of Wykeham is said to have done. It may also be noticed that he is not called master mason; or magister operum; or clerk of works; or supervisor; that the large monasteries had a staff of skilled workmen attached to their establishments, as also had the monarchs as part of their household; and that as the latter necessarily required the assistance of business people to superintend the erection of the buildings desired by them for strongholds or for magnificence, they called in the aid of churchmen, who might fairly be considered to do those duties the 'Royal Commissioners,' now perform; that if prelates were the actual architects—the designers of style and construction—some treatises would certainly have been left by them to record the fact; and that but for the accidental discovery of the MS. of Gervase of Canterbury, the choir in that city would always have been called the work of archbishop Richard instead of that of William of Sens, and of William the Englishman; the value of this discovery, as a warning against the belief that every ecclesiastic who is recorded as a 'builder' was an 'architect,' cannot be over-estimated.

Gundulf died 8 March 1108, in about the eighty-fifth year of his age, and was buried in Rochester cathedral, at the junction of the nave and choir. An episcopal statue, much mutilated, in a niche of the arcade on the west front of the north-west tower of the nave is supposed to be a representation of him. Memoir of Gundulf by Hugo, in the *Journal of the British Archaeological Association*, ix, 1854, 231-61. Paper read by HARTSHORNE, given in the *Journal of the Archaeological Institute* for 1863, quoting hitherto uncited passages from GERVASE, *Actus Pontif. in Decem Script.*, fol., London, 1652, p. 1664; and from the *Continuation of FLORENCE OF WORCESTER*, in *Flores Hist.*, fol., Frankfurt, 1601, 662, the bearing of

which requires careful investigation; the substance of the paper is noticed in *BUILDER Journal*, 1863, xxi, 672; and *GENTLEMAN'S MAGAZINE*, Oct. 1863, 448: with further remarks on Gundulph in *BUILDER Journal*, xxi, 543, 564, 812; *NOTES AND QUERIES Journal*, 3rd series, iv, 321; and *Transactions of the Royal Inst. of British Architects*, 1863-4, 127, et seq. A. A.

GUNETSRAINER (JOHANN BAPTIST), built 1722 at Augsburg the modern portion of the "Three Moors" hotel; and designed the Obwexer and Bassi mansions. He built at Munich 1732 the *damenstiftskirche*; and 1740 the Törring palace in a modern Italian style; at a later period the side of this building towards the New Residence was completely transformed, "after the old Greek fashion," with coloured decorations. He also built the church at Andechs. The date of his death has not been ascertained. 68.

GUN METAL. An alloy of copper with tin, much used for the bolts and inner works in the best locks, and by mechanical engineers for the purpose of forming the bearing of the revolving parts of machinery, on account of the diminished friction which takes place upon it; and it is sometimes also used by military engineers for the purpose of making brass ordnance, on account of the greater toughness of the metal than that of cast or wrought iron. It is composed of variable proportions of tin and copper, according to the use it is intended to apply the metal to, from 1 to 10 to 1 to 8, or even 1 to 7; the first is the proportion most used by engineers; the second by gun founders. The specific gravity of the alloy is in the first case 8.4290; in the second 8.1100; in the third 7.8970.

Of late the attention of engineers has been called to the composition of gun metal by the introduction of an alloy, known as the *sterro-metal*, which is said to possess great tenacity, and to be well adapted for casting cannon. This alloy consists of copper 55.04; spelter 42.36; iron 1.77; tin 0.83; which proportions have been varied to copper 57.63; spelter 40.22; iron 1.86; tin 0.15, without the quality being affected: the specific gravity of the forged metal is 8.37; that of the same metal drawn cold is 8.40; the tensile strength is said to be 28 tons on the square inch, cast; forged red hot 32 tons; and reduced cold to the dimension of wire 37 tons. Aluminium bronze composed of one part of aluminium to nine parts of copper, had, however, a tensile strength of 43 tons to the square inch. *TIMES Newspaper*, 12 Dec. 1862, and 3 Feb. 1863. G. R. B.

BUCHANAN, *Millwork*, 8vo., London, 1841, 260, states that in Rennie's experiments, given in the *Phil. Trans.*, it required 36,368 lbs. to tear asunder a bar one inch square of hard gun metal. He gives the proportions as 11 of tin to 96 of copper, or more usually 11 to 108; while a proportion of about 1 to 6 is used for bearings, bushes, and some purposes in machinery. Where gun metal is used for the bearings of the revolving parts of iron machinery, it is fitted in, as a lining to the iron, and is called the 'bush': this name is varied, at least in America, into 'box', for the similar metal fitting in the nave of a cart or coach wheel, perhaps through its being externally of a square form. The portion of the shaft or axle which revolves in the bush is called the 'journal'. J. W.

CUNTA, or chain used by surveyors in Hindostan, should have been 33 English ft. in length, but from the rudeness of the workmanship it had stretched to 33 ft. 10½ ins.; hence by the standard the acre would be equal to 40 guntas, but by the actual chain it would be equal to only 37½ guntas; 45 guntas, each 33 ft. square or 49,005 square ft., are equal to an average 'moray', and which is therefore nearly 1¼ acre, as used in the southern parts of Canara; BUCHANAN, *Mysore*, etc., 4to., London, 1807, iii, 2, 102.

GUNTER'S CHAIN, see CHAIN.

GUNTER'S LINE, also called the line of numbers, is put upon the two-foot rules used by carpenter's, etc., for facilitating their performance of arithmetical operations. 4.

GUNUNG DIENG or **GUNUNG PRAHU**. A mountain in Java. Next to Boro Bodo (BOROBUDOR) in importance are the extensive ruins on Gunung Dieng, the supposed residence of the gods and demigods of antiquity, where on a table land about 1600 ft. above the level of the sea are the remains of various (Buddhist) temples, idols, and other sculptures, the ascent up from the level of the country about 600 ft., being formed on each side of the mountain, and consisting of not less than 1000 steps each. Adjoining is a table land, perhaps itself a crater of a vast volcano, on the borders of which are four temples of stone greatly dilapidated; the largest of them is about 40 ft. square, the walls are 10 ft. thick and the height about 35 ft., the interior is about 20 ft. square with only one entrance. The roof is arched to a point in the centre about 20 ft. high above the walls; so that the whole building was almost one solid mass of masonry of cut stone in blocks of from 1 to 2 ft. long and about 9 ins. square, now rent to the bottom, the entablatures exhibiting delicate and very elegant sculpture. Near the centre of the plain are four more temples nearly similar to the above, but in a much better state of preservation, the sculpture being in many places quite perfect. Traces of the sites of nearly 400 temples were discovered having broad and extensive streets running between them at right angles; a ground plan and sketches have been made by Capt. Baker; drawings of one temple in its original state as discovered in 1815, with a restoration, are given in *RAFFLES, Java*, 4to., London, 1817, iii, 30-2.

GUNZ (ANTON), was imperial architect at Prague, probably about 1700-50, where he completed the royal *bury* that had been commenced by R. Lurago.

GURDA KAMBHA. An erection in front of a pagoda, in Hindostan. It is generally an octangular granite shaft often 40 ft. high; *ROYAL ASIATIC SOCIETY Journal*, 8vo., London, 1843, vii, 127.

GURGOYLE, see **GARGOYLE**.

GUSSET PIECE, see **CHEEK**. This term is also applied to brackets or angular pieces of iron used to strengthen, to keep steady or to support, a framing.

GUT. A term used in parts of Scotland for a sash bar; in the south west parts it is called 'astragal'.

GUTIERREZ (ANTONIO) designed 1504 the entrance archway to the winter chapter-house of the cathedral at Toledo.

GUTIERREZ (PEDRO) succeeded after 1600 to J. de Ribera Rada in continuing the Dominican monastery of S. Esteban, commenced 1524 by J. de Alava at Salamanca.

GUTTA (It. *goccia*; Sp. *gota*; Fr. *goutte*, *larme*; Ger. *tropfen*). A drop. The Latin name given to each ornament cut under the tænia in the architrave of a Doric order; and also to each similar ornament pendent from the soffit of the mutules; they have been supposed to represent raindrops hanging before they fall. *VITRUVIUS*, iv, 1, considered that the Corinthian order was entitled to use such an entablature. Six of these guttæ usually occupied the same width as the triglyph, and were not only used under it, but were sometimes introduced in the architrave when there was no triglyph in the frieze; either continuously, as in the choragic monument of Thrasyllos at Athens, externally; or at regularly spaced intervals where triglyphs might have occurred, as on the Parthenon at Athens; at the temple to Nemesis at Rhamnus; and at the temple to Jupiter Panhellenius in Ægina (on the inside of the portico or pronaos in each case); or under substitutes for triglyphs, such as the bull-headed sculptures at Delos. The supposition that the guttæ were not considered to be indispensable portions of the entablature seems to be countenanced by the absence of them in the pronaos of the temple to Concord at Agrigentum, and on a fragment found at Heraclea (wrongly called Myus) which had no mutules (a practice adopted by Delorme); on the triple archway at Patara, which has neither guttæ in the architrave nor mutules; and on the

temple at Cadachio, which has neither guttæ, triglyphs, nor mutules. The pseudo-dipteral temple at Pæstum, and the temple to Jupiter Polieus at Agrigentum had triglyphs, but the listel and guttæ could never have existed under them; and the hexastyle temple at the same place has a continuous molding without guttæ beneath the tænia.

The form of the guttæ seems to have been either that of a cylinder, a cone, or a conoid, generally connected at the back with the architrave in the Greek buildings, *e.g.* losing of its plan, nothing at Pæstum, .026 at Rhamnus, .084 at Delos, .153 at Phigalia, and .179 and .250 at Athens; but that of a cone losing .500 at Albano, and .583 at Rome. It seems to have been reserved for modern times to make an innovation reproved by CHAMBERS, *Treatise*, fol., London, 1759, who says "the drops are conical, as they are in all the Antiques; and not pyramidal, as they are very improperly made by most of our English workmen." In several cases the cone assumed to some extent the shape of a bell, from which cause it has been called *campana* and *campanula* (Fr. *clochette*); and prop (error for drop) or little bell by Moxon in his translation of BAROZZI, 12mo., London, 1702, p. 34. This shape has received notice only in the cases of the propylæa at Eleusis, shewn by the DILETTANTI SOCIETY, *Uned. Ant.*, fol., London, 1817, and of a fragment of the old Parthenon, engraved in PENROSE, *Investigations*, fol., London, 1851, pl. 40. Some examples occur in which the drops stood free of the architrave, *e.g.* the pronaos of the temple to Concord at Agrigentum, and the three large temples on the acropolis at Selinuntum according to SERRADIFALCO, who differs from WILKINS in this matter; and a tomb at Antiphellus; to which may be added the temple at Corinth, according to the diagram given in a note to the description of that building in STUART, *Antiq.*, fol., London, 1827 (vol. iii), and the hypæthral temple at Pæstum. With regard to the assertion that some guttæ were rectangular, and that all those found in Sicily are cylindrical, it may be suggested that the work may not have been finished, or that drawings in outline to a small scale of entablatures like that of the Doric portico at Athens, as given in STUART, *Antiq.*, i, do not show the detail of the guttæ (say a batter of 6 per 100 in height) with accuracy: thus, the drops on the temple to Apollo Epicurius at Bassæ are unequivocally marked as conical by COCKERELL, *Temples*, etc., fol., London, 1860, but as cylindrical on the front of the building and conical on its pronaos by DONALDSON, in the supp. vol. to STUART, fol., London, 1830. The bottom of the guttæ under the triglyphs on the northern temple outside the citadel at Selinuntum is sloped upwards back to the architrave. PHILANDER's note on *VITRUVIUS*, iv, suggests that the drops under the triglyphs were conical, but that those under the mutules were cylindrical, "ut in theatro Marcelli animadvertimus", but the best representations show them all conical.

The number of six guttæ under the triglyph seems to be normal; perhaps the only exception is the case of five on the temple to Hercules at Agrigentum: but some latitude has been taken with the number under the mutules. The rule would seem to be that there should be eighteen to each mutule, six being in front; the mutules between the triglyphs of the middle and north temples on the acropolis at Selinuntum have only nine, three being in front; in the mutules, the temple to Hercules at Agrigentum has fifteen, five in front; the temple to Jupiter Polieus in the same city, and the middle temple outside the acropolis at Selinuntum, have twenty-four guttæ, six in front; and the temple at Albano (imitated in this respect by BAROZZI) has thirty-six. Twenty-eight are used by CHAMBERS, who, like BAROZZI, SCAMOZZI, and VIOLAZANINI, by teaching that the mutules should not be pendent, avoided deciding whether the axis of the drop should be at right angles with the slope or with the horizon, and might be justified by the example on the theatre at Segesta, and the instance at Albano. The best examples of Greek art showing the bottom of the guttæ parallel to the slope of the mutule

(whence in a geometrical representation the bottom line is a curve), would lead to the expectation that the axis is at right angles with the slope: but there are perhaps only three examples of anything like this method of working the guttæ; viz. the temple at Bassæ, where the axis is perpendicular to the slope according to COCKERELL (but to the horizon as shewn in the supp. vol. to STUART); the temple to Nemesis at Rhamnus, where the axis is so far inclined that the front of the drop is perpendicular to the horizon, as shewn in the *Uned. Ant.*; and the Doric entablature at Athens, which has nearly the same effect. Such modern architects as made the mutules slope have, like Palladio, kept the axis true to the slope. But in almost every other good example of Greek work, the axis seems to have been made perpendicular to the horizon; and therefore the elevation of the drop would have a curved line at the bottom; indeed the plan of the bottom of the drop must be presumed to be elliptical if the upright face were produced by a lathe. The Greeks could work the front with a curvature fuller than that given to the back (in section) of the drop; a remarkable instance seems to occur in the cornice of the temple to Diana Propylæa at Eleusis. The bottom of the guttæ in the mutules was ornamented by SCAMOZZI.

With regard to the mutules of the temple at Bassæ, it is observed by DONALDSON, in the supp. vol. to STUART, that "none of the guttæ of the mutules are cut out of the solid, but have joggles which are fastened into the matrices prepared on the soffit of the mutules: that is, each drop is a small cylindrical piece of stone let into the holes sunk in the substance of the mutules: some of the guttæ of the great temple at Selinus in Sicily and at Paestum are managed in the same manner." Of this Paestan hypæthral edifice WILKINS, *Antiq. of Magna Græcia*, fol., Cambridge, 1807, p. 60, had previously remarked "the drops below the triglyphs are conical, as were also those in the mutules, if we may judge from the form of the holes cut in the under surface to receive them: it is singular that not one remains in this situation; a circumstance which has led some to infer, that they were formed of stucco, or some other perishable composition", a surmise rendered more probable by the possibility that the whole surface of the building was stuccoed over.

The proportions of the guttæ and of the interval between each pair, on the architrave as well as on the mutule, appear to be as loose as those of any other detail of Greek art. Besides mention of the extraordinary instance found at Halicarnassus of the employment of a drop in the space at the top of each angle-channel of a triglyph illustrated in a note by DONALDSON as above quoted, notice should be taken that the use of the drop as a leading element of decoration (perhaps derived from the triple continuous series in the soffit of the example at Cora) has produced some of the best variations of cornice that the present century has invented. LARMIER.

GUTTA-BAND. The listel from which the guttæ seem to hang. It is called *regula* by VITRUVIUS, iv, 3, who notices its length as being the width of the triglyph, and its height with the guttæ as one-sixth of a module. But on the temple to Apollo Epicurius at Bassæ all the bands are shorter according to DONALDSON, in the supp. vol. to STUART; and longer on the entablature at Athens, given in the same volume; on the temple to Nemesis at Rhamnus; on the example at Cora; and on the pronaos of the hypæthral temple at Paestum. The relation between the angle-triglyph and this band seems to offer some indication of the age of the building: the band is stopped short of the extent of the architrave on the temple in *antis* to Jupiter in the acropolis at Selinuntum, and (according to WILKINS, *Magna Græcia*, fol., Cambridge, 1807) on the temple at Segesta; and on the pronaos of the temple to Concord and Jupiter at Agrigentum. In the examples at Athens the band stops at the full extent of the architrave, even if (as at the Propylæa) it should thereby be less in width than the triglyph; at the Thescion and the Parthenon the Vitruvian rule is ob-

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served; the band advances to break beyond the line of the architrave on the entablature at Athens above mentioned; and it advances beyond the architrave to the extent of the projection of the triglyph at Antiphelessus, as well as on the temple to Jupiter and the portico of Philip in the island of Delos: this point in the temples at Agrigentum should be carefully studied in any speculation as to the period of their construction, because WILKINS and SERRADIVALCO differ in their representations of the work. The face of this band has a batter of about 4 per 100 of height on the temple to Theseus at Athens, and at the temple at Bassæ; a batter is shewn to the face on the middle and north temples in the acropolis, and on the north temple outside the citadel at Selinuntum; and on the temple in the island of Ægina, as well as on the exterior of the Propylæa at Eleusis: and a batter of the face and sides was recommended by PALLADIO and BAROZZI, and was executed on the portal of the Orti Farnese at Rome by the latter, as shewn by DONALDSON, *Doorways from Modern Buildings*, 4to., London, 1836, pl. 30. This member does not occur in every example of a Grecian Doric entablature: it could never have existed on the pseudo-dipteral temple at Paestum, nor on the temple to Jupiter Polieus at Agrigentum; while it is replaced by a molding on the triple archway at Patara, and on the hexastyle temple at Paestum; and is converted into a molding over the guttæ in the example at Albano, as well as in the baths of Diocletian at Rome, in both these cases the gutta-molding and tenia break round the triglyph: this practice was familiar to PALLADIO and SCAMOZZI, but was avoided by BAROZZI. Indications of coloured decoration upon a guttæ-band are given by PENROSE, *Invest.*, fol., London, 1851, pl. 22; and it was coloured blue under a red tenia in the little temple in *antis* on the acropolis at Selinuntum; on the temples to Castor and Pollux and to Hercules at Agrigentum; and on the temple of Jupiter in Ægina.

GUTTA PERCHA, or *Getah pertja* of the Dutch islands. The concrete juice of the tree, *Isonandria Gutta*, called 'niato' by the natives of the Malayan archipelago, where the tree grows wild, and whence the juice is exported largely to England through the port of Singapore. It is obtained by tapping the trees. Gutta percha seems to have been introduced into England by Dr. Montgomery in 1843, and the first articles of use made of it were laid before the Society of Arts in 1844: the first fair ship load, of 500 tons, was sent in October 1849. The system then adopted for collecting the juice, namely, cutting down the tree for the sake of a few pounds of the material, seems to have been retained to the present time, which may account for the comparative scarcity and the high price of the raw commodity. It is prepared in England for manufacture by being cut into thin slices by powerful machines for that purpose, after which it is boiled and cut into shreds, dried and masticated by kneading machines similar to those used for caoutchouc. Gutta percha is soluble in naphtha, chloroform, and other menstrua. It is now largely used in the preparation of stamped ornaments, bands, straps, anchor floats, waterproof fabrics, soles for boots, funnels for certain chemical purposes, tubes for the conveyance of water and of sound, and for the coating of electrical wires, being a non-conductor of electricity. The mycelium of a fungus, which frequently grows on the dead roots of oak trees and sometimes under hawthorn hedges, was found in 1857 occasionally to attack the gutta percha covering telegraphic underground wires, fermenting and rotting the parts wherever the fungus prevailed, the other parts remaining uninjured; *BUILDER Journal*, xv, 179. G. R. B.

A difference of opinion exists as to whether gutta percha

water-pipes will last underground or decay rapidly; perhaps

arising from the nature of the various soils. It is also uncer-

tain whether this material can be guaranteed as a lining for

cisterns.

Experiments were made in 1849 at the Birmingham Water

Works on the strength of gutta percha for tubes. The

tubes $\frac{3}{4}$ in. in diameter and $\frac{1}{4}$ in. thick, were attached to

the iron main and subjected for two months to a pressure of 200 ft. head of water without being in the slightest degree deteriorated; they were afterwards connected with the hydraulic proofing pump, the regular load of which is 250 lbs. to the square inch, at which point the pipes were unaffected, and though the pump was worked up to 337 lbs. the tubes still remained perfect. The gutta percha being slightly elastic the tubes expanded under the great pressure, but on its withdrawal they recovered their former size; *CIVIL ENGINEER Journal*, xii, 255. Other experiments were made in 1850 at Stirling. The tubing 1½ in. bore was attached to the water pipes, and although the pressure of the water is perhaps the greatest in the kingdom, being about 450 ft., not the slightest effect could be perceived either in the tubing or in the joints, whilst the same pressure upon strong leather hose scattered the rivets in all directions; *ARCHITECT Journal*, ii, 82.

WHISHAW, *Explanation of the various applications of Gutta Percha*, read before the BRITISH ASSOCIATION, etc. at Swansea, August 9, 1848; given in the *PRACTICAL MECHANICS' Journal*, i, 164; DODD, *Curiosities of Industry*, 8vo., London, 1851.

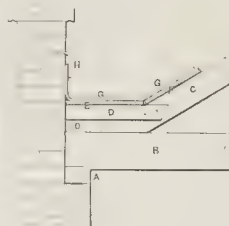
A new gum called Balata, obtained from Demerara, has lately been introduced (1863-4) as a substitute for gutta percha.

GUTTER (Lat. *canalis*; It. *doccia di gronda* (frequently shortened to *gronda*, *grondajo*, and *grondea*); Sp. *canalera*; Fr. *chêneau*, from *chenal*; Ger. *trauerinne*). The horizontal contrivance by which the water falling on a roof is conveyed with a fall to the point of vertical discharge. So long as it fulfils these conditions, it is a gutter, whether it be an open or a closed tube; custom has, however, distinguished between a trough and a gutter, as will be noticed hereafter: technically the gutter is the canal at the top, and the channel is the canal at the bottom, of a wall. CHAMFERET; CHANNEL. The term is derived from the Latin *gutta* as 'caves', through the late Lat. *gutteria* a 'gutter', and *guttera* a 'channel', and also a 'down-pipe'; the Fr. *gouttière* had the precise meaning of GARGOYLE till about 1764, when spouts were prohibited in Paris, as noticed in the *REVUE GÉNÉRALE*, 1843, iv, 51-9; but the present meaning as used in those pages is clearly that of an EAVES-ROUGH. The small gutter sometimes made in masonry is called in It. *canaletto*, *canalino*; Sp. *canalajera*, *canalita*; and Fr. *goutte*; though *gargouille* seems to have been the name for a little gutter until it became appropriated to the actual spout. RAIN WATER PIPE.

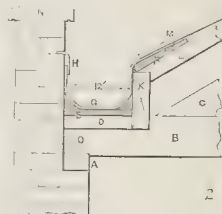
Three situations have to be considered with reference to a gutter: either inside the wall, on the wall, or outside. The first is the most usual, and the worst, position, because a crack allows the building to be flooded; the second is not now common, but is equally or more dangerous, because water might pass for a considerable time before a crack is discovered; the third is clearly the safest as regards a crack. But inasmuch as the third offers no security against accidents, and is open to the charges of difficulty and expense, the first has prevailed in important buildings from the reintroduction of gutters about the middle of the twelfth century in Normandy, but nearly a century later in Burgundy and Champagne, according to VIOLETTE DUC, *Diet.*, s. v. *chêneau*, to the present time, wherever gutters and down-pipes have been used; that writer notices the general absence of gutters from the houses in Paris so late as 1830: yet out of the numerous examples of the construction of gutters given in ROMBERG, *Zimmerbaukunst*, 4to., Leipzig, 1846, pl. 47-9, only the four cases 507, 517, 520, and 531, belong to this class.

Gutters placed on the feet of the rafters just within the external walls of a building are generally screened by a low wall, and have thence derived the distinguishing name of parapet gutters. In Fig. 1, A is the wall plate; B the tie-beam, or the ceiling-joint, as the case may be; C the common rafter; D the gutter bearer; E the gutter board; F the lear board, the eaves board, or the tilting fillet, according to its

make; G the puncheon, notched to receive the bearers when



the latter are not allowed to enter the parapet; H the metal lining; I the flashing; and J the feather-edge or weathered-back coping. When the common rafters are placed, the gutter bearers are fixed so as to give a fall of not less than 1½ in 10 ft., and the gutter boards of 1½ to 1 in. of yellow deal nailed on with proper rebated drips, etc. Lear boards of ½ stuff are then fixed and the lead laid, turning up over the lear board according to the pitch of the roof not less than one foot, and up the wall not less than 6 ins., with proper flashings; the possible depth of water in the gutter being taken as from 6 to 9 ins. Parallel gutters are those having upright sides like square middle gutters, as Fig. 2, to which the references above described also apply; and in addition, K is the pole plate, or the gutter plate; L the common rafter; M the slating, which is often recommended to be set back to let the leadwork show up the slope, as with thin slates they are apt to be broken when they project, by persons passing along the gutter; and N the saddle-back coping. In

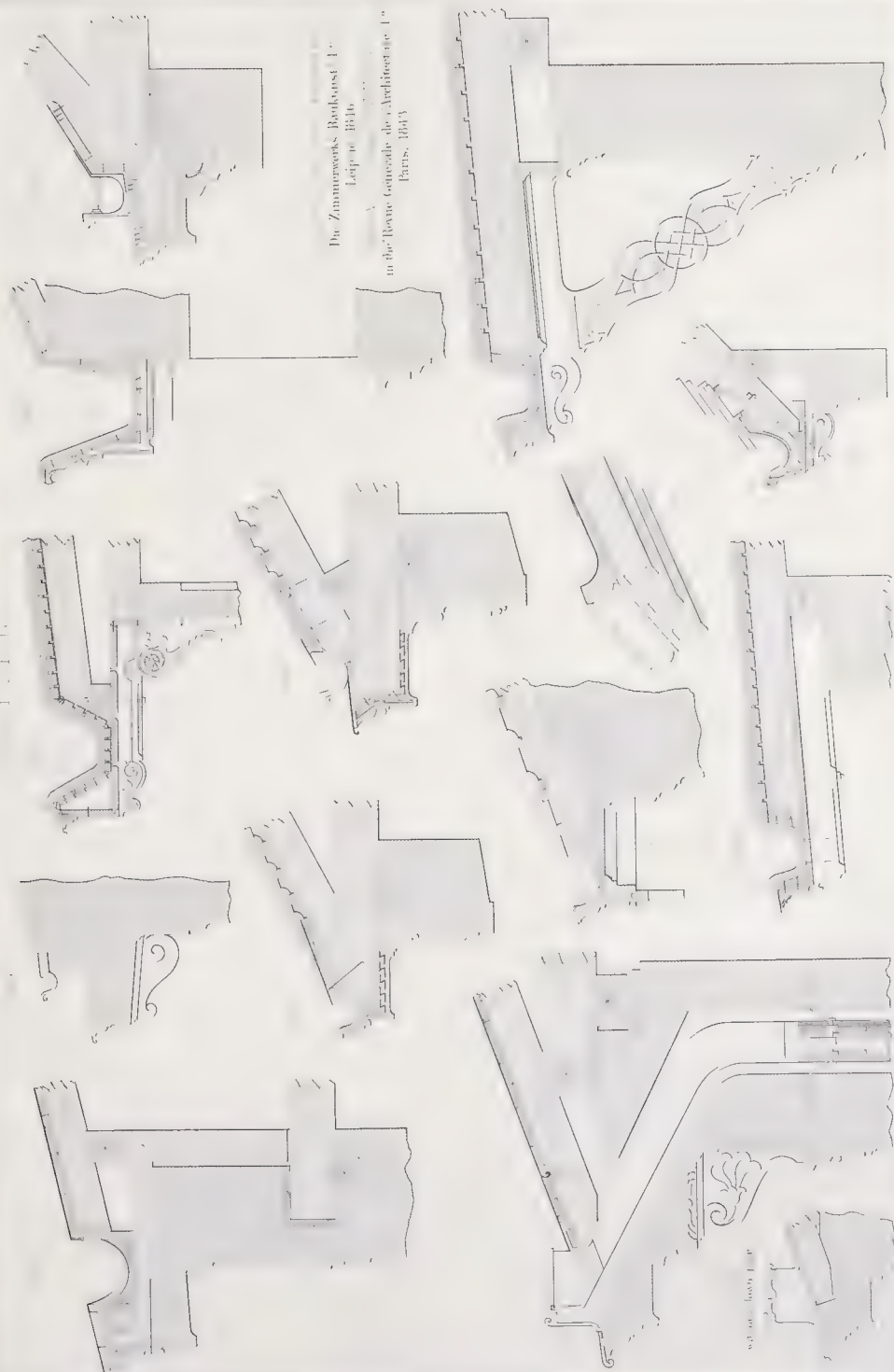


wide gutters, angle pieces are placed on the gutter board so as to form a rounded shape to the metal work, and prevent it from being cracked by the foot. Parallel gutters should be about 12 ins. wide between roofs, but 15 ins. next to parapets.

Chimney gutters are formed on the same principle, but consist only of a very narrow gutter and lear boards, as described s. v. FILLET GUTTER. Middle gutters are those to M or V roofs, and are similar to those first described, except that as there is no parapet they have lear boards on both sides; and, where there are no longitudinal walls, the feet of the rafters pitch on a strong gutter plate either reaching from cross-wall to cross-wall, or supported by the partition-heads, or by columns: this plate is sometimes trussed. All these were formerly known as BRIDGED or CRADLE GUTTERS. To the class of middle gutters belong the Paxton gutters which, as used in the Exhibition of Industry 1851, were 24 ft. long formed of timber, trussed with wrought iron rods and screwed up with a camber, resting at each end on the girders (24 ft. apart), which also carried wooden troughs to convey the water from these gutters to the pipes forming the columns. Valley gutters are of two sorts, both used where two roofs intersect. The first are constructed simply by nailing narrow lear boards on the common rafter and laying lead or other metal, varying in width according to the pitch of the roof, with proper laps. The second are of hollow tiles which extend a sufficient distance on each roof and overlap each other vertically, so as to discharge the water into the main gutter. VALLEY TILES. For a secondary gutter within the walls, see GABLE. In all cases the thickness and width of the lead or other metal will depend on the extent and pitch of the roofs, and the frequency of the opportunities of carrying down the water.

A. A.

Cisterns to collect water should occupy the whole width of the gutter, and be about 18 or 24 ins. long by 8 or 10 ins. deep, opening at the bottom into a pipe of sufficient size for carrying off the water. This pipe, but frequently the cistern itself, has a leaden cover perforated with holes half an inch in diameter, to prevent leaves, etc., passing down the pipe. It is also desirable that along the gutter should be placed wooden



Die Zimmermanns' Bookcase 1^{re}
Lith. in 1816

in the Royal Collection de l'Architecte 1^{re}
Paris, 1813

see also page 100



gratings, strong enough to bear the weight of a man, to keep snow from freezing in masses in the gutters, and to prevent the lead from damage by persons cleaning or repairing the roofs. Various methods have been tried to construct gutters of asphalt, concrete, cement and tiles, etc.; but all have been more or less failures, as they do not afford adequate facilities for contraction and expansion.

PAPWORTH, *Rural Residences*, 8vo., London, 1818, p. 85, remarks that "lead is the best material for making gutters; copper and zinc are both objectionable on reasonable grounds. Compositions of many kinds have been devised, but have failed in perhaps every instance; the hard ones crack with the least settlement of the building, or the springing, swelling or shrinking of the timbers connected with them; the soft ones soon lose their tenacity by the operation of the sun; and those that have been devised of a medium composition, become hard in winter and dry in summer, and consequently crack in both seasons." He further observes, 37-8, that "the chief objections to lead for gutters, or rather the difficulties that occur in the proper application of it", arise from "the contraction and expansion, to which it is subject from cold and heat, as from the sudden changeableness of our climate the transition from one extreme to the other is very great in the short space of twelve hours. Lead should be put together in comparatively short pieces, never admit the too frequent practice of soldering lengths of it together, that the contraction and expansion may take place on as short surfaces as possible. The pieces of lead are connected with each other at a small step (or DRIP) of about $1\frac{1}{2}$ in. high, the under sheet of lead rising upon the step and the other folding over it:—when water in the gutter, prevented from escaping by any impediment, is deep enough to cover this step, it finds a way under the covering sheet of lead, and thence into the wall or the apartments. This overflow has never been wholly prevented: a simple and novel contrivance, which has completely succeeded, is here submitted. Every step, or technically, every lap, should be formed as usual, but the gutter boards grooved or hollowed at the edge of the under lead and perforated so as to let the overflow water pass readily into a small transverse subgutter, previously prepared immediately under every lap and discharging itself upon the cornice (or elsewhere), these gutters would be about 18 ins. long, and at intervals of 12, 14, or 16 ft. The security is ample and the expense inconsiderable; they are applicable in this way, however, only to the wall gutters; those to the valleys of the roof must have a sub-trough gutter also." The *Builder's Dictionary*, 8vo., 1734, recommends that "gutters should never have less than a quarter of an inch to a foot for the drip, and the soldering across the gutter is always to be avoided; the length of the lead from fall to fall should never exceed 14 ft." It will be noticed the word 'drip' here means the fall or incline of the gutter; and the 'fall' what is now called the DRIP. Cast lead of the weight of at least 8 lbs. to the foot was usually used in the best work; the improvements, however, in milled lead have rendered 7 lbs. an unobjectionable substitution.

As regards the second position of the gutter, viz. on the wall itself, it may be said that, except the base of $4\frac{1}{2}$ ins. allowed by the Building Acts in London, and the cases shewn by ROMBERG, figs. 519, 522, and 524, examples of the use of a gutter in such a position are almost entirely confined to mediæval works: the least height of the cheek or side (Fr. *bahut*) under the eaves is frequently insufficient; it may be seen so little as one inch, whereas in ordinary roofs having a span not more than 30 ft. it ought never to be less than about 3 ins., and in mediæval times was frequently 24 ins., as here sketched from VIOLET LE DUC, *Dict.*, s.v. *bahut* and s.v. *construction*, p. 194, whose description, pp. 187 and 191, of guttering to the church of S. Urban at Troyes might serve as an amplification of the remarks made upon the resemblance at Kilmallock between the ancient Greek and the



mediæval Irish guttering by DONALDSON, *Wayside Memoranda*, in *Transactions* of Royal Inst. British Architects, 1857-8, p. 148. A stone or metal trough serving as a gutter is often placed, as in mediæval times, against a wall under the filleting of a roof running into it, as described s.v. GABLE.

As regards the third position of the gutter, viz. outside the wall, it may be observed that there are three classes in this arrangement: at the eaves, in the cornice, and above the apparent eaves. The first class includes the EAVES-TROUGH, the *chêneau* of VIOLET LE DUC, *Dict.* s.v., who speaks of it as the practice of the thirteenth century in France. To this class belong all troughs, as shewn by ROMBERG, figs. 500 K and L (the *chêneau en queue de vache* of French workmen), whether aris, box, or half-round, or ogee, of wood, stone, or metal; because a gutter is supposed to have a continuous bearing more solid than that which is afforded by spikes, hooks, or brackets; yet the latter frequently form the chief support of a real gutter. In the second class must be placed the EAVES-CHANNEL, the *chêneau* of VIRLOYS, *Dict.* s.v., used in the practice of the Greeks and of the Romans, in terra cotta, or in stone: this system reappeared, according to VIOLET LE DUC, in the Ile de France during the thirteenth century: and became in woodwork a very complicated matter, as shewn by ROMBERG, figs. 504-6, 509, 513-5; which was apparently simplified by JANNIARD, in the *Revue Générale*, 1843, iv, 51, 230; reference is made to these two books because they afford a large number of hints, for the introduction of gutters as decorative features, whence may also be derived suggestions for the management of fire-proof eaves. The third class includes the construction of the gutter upon the cornice so that there seems to be a portion of roof between the gutter and the street; apparently this is the *chêneau à bavette* of DE QUINCY, *Dict.* s.v., and is shewn in ROMBERG, figs. 510-2, 521, 530, who exhibits figs. 516, 518, a sunk gutter which forms a modification of this class. These conditions of the third class are paraded as the simplest and best gutters for cheap buildings by DOWNING, *Country Houses*, 8vo., New York, 1850, p. 189-90, whose 'sunk metal gutters' especially, had been tried in England more than thirty years ago, and was condemned for such purposes by PAPWORTH, p. 57-8, who observes that "concealed or invisible gutters, formed about 18 ins. or 2 ft. back from the eaves, are sometimes employed to arrest the rain-water before it arrives at the extremity of the roof, and conveyed to pipes prepared at the end of the building to receive it. Such gutters may be made very small, but are rendered troublesome by the cracking of the lead when laid in long lengths. A wood gutter at the eaves designed so as to appear as the finish of the roof is the best arrangement, a fall for the water being formed in its own substance." Some examples of gutters as used in France are given in *BUILDING NEWS Journal*, 1859, v, 1067; in *BUILDER Journal*, 1864, xxii, 355; and in *Illustrations*, s.v.

Some confusion arises from the disregard of the technical meaning of terms: thus an eaves-channel is frequently confounded with an eaves-gutter, the latter being really the old form of gutter to the eaves (not projecting beyond the walls) of a roof, viz. with one side following the slope of the roof, and consequently raking according to the fall given to it: the term eaves-gutter has, therefore, also been used for any gutter where the lead is turned on a lean board, in contradistinction to a box or trough, or rather PARALLEL GUTTER, where the lead is turned first against a cheek or plate; and also, by a curious concurrence of circumstances, has been used for the box-gutter itself, because the roof finishes into it with a dripping eave, in contradistinction to the valley-gutter.

At the *munster* of Freiburg in the Briesgau, the timbers, joists, and wall-plate, which would be liable to be injured by damp and wet, are laid higher than the gutters, and the intervals between the joists are not closed up externally, but left open to admit the air, while the gutters are formed of hollowed stone or metal. In modern practice the gutters are usually above

the level of the wall-plate and the timbers inserted into the stone, where they become again damp and ill consequences ensue; MOLLER, *Memorials*, etc., 8vo., London, 1836, p. 138, pl. vi. In 1670 S. Andrew's church, Dublin, was rebuilt; but in consequence of stone gutters having been used, the main timbers of the roof and upper part of the walls were found to be so dangerously decayed that in 1793 it was necessary to rebuild the upper portion of the edifice.

Cast iron for the middle valleys of roofs is used in the Midland Counties and found effective and economical, each end having a flange for joining the different pieces together. The requisite fall is found to be from a half to three-quarters of an inch in the yard, and appears to be well adapted for ridge and furrow hothouse roofs: illustrations are given in the *CIVIL ENGINEER Journal*, 1839, ii, 363, from the *GARDENER'S MAGAZINE*. Cast iron gutters are now largely used, and are shewn in several of the manufacturers' pattern books, in connection with iron roofs, with wood roofs, and with flats to gain light. The common cast iron guttering for eaves, when being fixed, should have the socket joints well packed with red or white lead mixed with linseed oil; and the brackets or supports be put up about 3 ft. apart.

The words 'grove or gutter' in Moxon, translation of BAROZZI, 12mo., London, 1709, p. 32, mean the flute of a column.

GUTTER BEARER. The sort of joist, as *p* in the above woodcuts, upon which the boarding for a gutter is laid.

GUTTER BOARD. The boarding, as *x* in the above woodcuts, generally $1\frac{1}{2}$ in. thick, which is laid on the bearers to receive metal. It should be laid with a fall of not less than $1\frac{1}{2}$ in. in every 10 ft., and with drips from 14 to 16 ft. apart. If the gutter should be more than one deal in width, two battens or deals should be used, ploughed and tongued together in best work. A. A.

GUTTER CLAMP. The band, plain or ornamented, which conceals the joints of a metal gutter-trough.

GUTTER HOOK. A wall-hook driven into a parapet at distances of 3 or 4 ft. to keep the sides of the metal against the wall, until and after the flashing is dressed. Iron hooks are bad, as they rust and fall out and tend to destroy the metal work: but hard wood or lead wedges should be used in best work.

The *Fr. crochet de chéneau* is rather a strip of flat iron bent to carry the trough at eaves (*Fr. chéneau à bord*), and a similar strip to carry the gutter above a cornice, which is also a *chéneau à bord*, but if the lead is twisted back so as to hide the irons it is a *chéneau à barette*.

GUTTER TILE. Besides being applied to the valley tile which has a conical form, this name has been given to EAVES TILES with one end turned up so as to form a trough, specified as Beadon's patent imperishable gutter tiles.

GUTTERALS AND GIBS. The term used in Scotland for 'gibs and cotters' to ironwork. GIB.

GUYMARD (. . .), see **GUIMARD** (. . .).

GUYTING QUARRY. There are two villages, namely, Temple and Lower Guyting in Gloucestershire; the latter is also called Guyting Power, and is five miles east of Winchcombe; the other is one mile further. It supplied the large stones employed in the erection 1825-7 of S. Peter's church at Birmingham, one in the architrave being 13 ft. long.

GUZ or GAZ. A measure of length used in Hindostan; see **BIGHA**.

GUZEL-HISSAR, in Asia Minor, see **AININ**.

GWILT (GEORGE) held 1770 the appointment of surveyor to the county of Surrey; his chief works in that capacity were the bridges at Cobham, Leatherhead, and Godalming; 1781-98 the county gaol in Horsemonger-lane; the Bridewell in Great Suffolk-street; and about 1790 the sessions house in Newington Causeway, pulled down in 1862. In 1774, on the passing of the Metropolitan Building Act, he was appointed district

surveyor for S. George's, Southwark; about 1777 was appointed surveyor to the Commissioners of Sewers for Surrey, extending from East Moulsey to the river Ravensbourne in Kent; and in 1800 was architect to the West India Dock Company, for whom with his eldest son George he designed six of the large warehouses in the Isle of Dogs. The late John Shaw, with George and Joseph Gwilt, were amongst his pupils. He died 9 December 1807. 14.

GWILT (GEORGE), F.S.A. (1815), born 8 February 1775, succeeded his father in his practice. In 1818 he restored the steeple of Bow church, Cheapside, rendered necessary by the exfoliation of a wrought iron tie-bar which had been worked into the masonry, causing the upper part of the spire to be tilted up very visibly; *BUILDER Journal*, 1852, x, 678; when the peristyle of columns and the obelisk, altogether for a height of about 42 ft. was rebuilt, and completed 11 July 1820, when the copper vane, in the form of a dragon, 8 ft. 10 ins. long, was fixed. The foundations of the church being subsequently found defective, some important works were carried out under his superintendence, during which the Norman remains of the original building were identified; and under the title *Observations on the Church of S. Mary-le-Bow, chiefly relating to its original structure*, a paper was read by him at the Society of Antiquaries June 1823, and published in the *Vetusta Monumenta*, v, 343-6, with six plates. The restoration of the choir and tower of the church of S. Mary Overies or S. Saviour, Southwark, was conscientiously carried out by him 1822-5, at an expense of £35,000. In 1824 he visited Italy. On his return he rebuilt the first ten almshouses of Cure's college, Park-street, Southwark; and 1832-4 superintended the restoration of the Lady chapel of S. Mary Overies, without remuneration, at a cost of about £3,000, described in the *GENTLEMAN'S MAGAZINE*, 1833, p. 254 (the nave was entirely rebuilt in 1839 by Henry Rose, at a cost of £8,000; and the transepts and altar piece in 1829-30 by R. Wallace). He exhibited at the Royal Academy in 1827 two drawings of his designs for this church. He also contributed two notices on the remains of Winchester palace in Southwark to the *GENTLEMAN'S MAGAZINE*, 1815, p. 244 and 513; with others in later years; and he formed an important collection of objects of antiquarian art in his house in Union-street, Southwark. He died 26 June 1856 aged eighty, and was buried in the family vault on the south side of the choir of S. Mary Overies.

He had three sons and four daughters: George, also an architect, who exhibited in 1823 "the new west end of S. Saviour's church; part of the design for rebuilding the nave, which obtained the premium of 100 guineas in January last", died early; as did also Charles Edwin, of the same profession, who contributed *An Account of the Remains of part of the Prior of Lewes's House, in Carter Lane, S. Olave's, Southwark*, given in the *ARCHÆOLOGIA*, xxv, 604. His third son, Alfred, survives. *BUILDER Journal*, xiv, 386; *Journal of the British Archaeological Association*, xiii, 161. A section of the old nave of S. Saviour's, taken by G. Gwilt and the late E. P. Anson, is in the collection of the Royal Institute of British Architects.

GWILT (JOSEPH), F.S.A. (1815), F.R.A.S. (1833), born 11 Jan. 1784, was the second son of the first named G. Gwilt. At the end of 1799 he was placed in his father's office; and in 1801 admitted a student of the Royal Academy, where he obtained the silver medal on the 10 Dec. for a drawing of the tower and steeple of the church of S. Dunstan's in the East. He exhibited at the Academy as early as 1800: in 1807, the titles of his two works were "The Louvre, from sketches and memoranda made by J. S. Hayward, esq., in 1802; the statues and basso-relievos are introduced agreeable to the original intention of Perrault", this is probably the original for the etching he made in 1804 for the pamphlet by his friend TAPPEN, *Tour through France*, etc., 8vo., London, 1804; the other being a "Cottage lately erected on the estate of Mr. alderman Ansley, near S. Ives, Hunts"; and for whom in 1810 he had a "design

for alterations, etc., at Houghton, Hunts"; in 1813 he sent his design for a "memorial to Lord Nelson at Dublin", submitted in 1806; as well as for a "timber bridge of five spans intended to cross the Wye at Hoarwithy, Herefordshire". He visited Italy, etc., during the years 1816-8, returning in the latter year; and in 1820 exhibited, besides a Florentine subject, the "east end of a conservatory about to be erected at Lee Grove, Kent, for T. Brandram, esq."; in 1822 the "staircase of a prebendal house in Little Dean's Yard, Westminster" (a work attributed to Inigo Jones), afterwards published in BRITTON and PUGIN, *Edifices of London*, 8vo., London, 1825-8, ii; and is also given in KENT or WARE, *Designs*, etc., 8vo., London, 1743. He completed in 1823 for new London bridge, and was placed first by the referees, but did not obtain the first premium; in 1830 he exhibited a "design prepared in 1827 for the rectory house of East Woodhay, Hampshire"; and in 1843 "Markree castle near Sligo, completing for E. J. Cooper, esq.", in which he was associated with his son; as well as in laying out for building purposes the estate of Sir T. M. Wilson, Bart., at Hampstead.

Besides the above, he erected the church at Lee near Lewisham, lately pulled down; 1819 arranged the land approaches to Southwark bridge; erected the Byzantine church of S. Thomas at Charlton near Woolwich, given by HOSKING, in the article *Architecture* of the *ENCYCLOPÆDIA METROPOLITANA*, 8th edit., 1853, p. 506, pl. 63; with numerous other buildings of no important interest. In 1828 he made alterations to the hall of the Grocers' Company, built by T. Leverton, comprising the front towards Princes-street, Bank, and rebuilding the house of the clerks; to this company he was surveyor, as also to that of the Waxchangers, to the Imperial Fire Assurance Company; and to the Commissioners of Sewers for Surrey and Kent, succeeding his father, but he resigned the office about 1845. Much of his practice consisted in consultations with the Office of Woods and Forests, and with Committees and Commissions on various subjects: with F. C. Penrose, he assisted in drawing up a proposition for a new Metropolitan Building Act, 1855. Whilst abroad he obtained a complete set of moulds and casts of the capital and entablature of the then called temple of Jupiter Stator at Rome; and of those of the temple of Vesta at Tivoli, which were subsequently brought over; *ELMES, Lectures*, 8vo., London, 1821, p. 254.

Gwilt's numerous literary publications comprise: *On the Equilibrium of Arches*, etc., 8vo., 1811, 1826, containing his design for London bridge, and 1839 without his sanction; *Notitia Architectonica Italiana*, etc., 8vo., 1818, prepared from MILIZIA, *Lives*, etc., for his tour in Italy, and published on his return, with various memoranda; *Cursory View of the Origin of Caryatides*, priv. print., 8vo., 1822; reprinted in his edition 1825 of CHAMBERS' *Treatise*, p. 53; *Sciography, or Examples of Shadows*, 8vo., 1822, 1824 with additions and improvements, 1833; a pamphlet on the rebuilding of London bridge, entitled *The Conduct of the Corporation*, etc., 8vo., 1823; *An Historical, Descriptive, and Critical Account of the Cathedral Church of S. Paul, London*, read 4 March before the "Architects and Antiquaries Club" and ordered to be printed, 8vo., London, 1823; this was reprinted, with some additions by Brayley, in BRITTON, etc., *Edifices of London*, 8vo., London, 1825-28; a sheet engraving, being a *Comparative View of the Four Principal Modern Churches in Europe by means of Transverse Sections to the same scale*, 1824; a new edition of the *Treatise on the Decorative Part of Civil Architecture* by Sir W. CHAMBERS, with an *Introductory Essay on Grecian Arch.*, and a memoir by T. Hardwick, 8vo., 1824-5; the translation of the *Treatise on Architecture* by Marcus Vitruvius POLLIO, 8vo., 1826; *Rudiments of Arch.*, *Practical and Theoretical*, 8vo., 1826; 1835; 1839; the *Ordinary* to N. H. NICOLAS, a *Roll of Arms*, 8vo., London, 1829; *Observations on the communication of Mr. Wilkins relative to the National Gallery*, 8vo., 1833; the article *Art of Music*, for the

ENCYCLOPÆDIA METROPOLITANA, 1835; *Rudiments of the Anglo-Saxon Tongue*, 8vo., 1835; *Elements of Architectural Criticism*, 8vo., 1837; 1839; and *Appendix*, 1837; *Project of a National Gallery on the site of Trafalgar Square* (with his son), 8vo., 1838; *Encyclopædia of Architecture, Historical, Theoretical, and Practical*, 8vo., 1842; 1845; 1854; 1859; and *Appendix of Gothic Arch.*, 1845; 1851; all the articles relating to architecture, music, and the fine arts, in BRANDE, *Dictionary of Science, Literature, and Art*, 8vo., London, 1842, and 1853; a pamphlet with L'ANSON and NEWMAN, *Sewers, Surrey and Kent*; *Reports*, etc., 8vo., 1843; and lastly, a new edition of NICHOLSON, *Principles of Architecture*, etc., 8vo., 1848, revised and a plate supplied. A few minor works appeared in some periodicals; as, *Observations on the Heights of Entablatures*, in the *Transactions of the Royal Inst. of British Architects*, 4to., London, 1842, 123, containing some curious laws of proportion.

He died 14 Sept. 1863, in the eightieth year of his age, at South-hill, Henley-on-Thames, where he was buried. Amongst his pupils were J. L. Wolfe, and his son John Sebastian Gwilt, who furnished a memoir published in the *Transactions of the Royal Inst. of British Architects*, 1863-4.

GWYNN and GWYN (JOHN). A native of Shrewsbury in Shropshire, the year of whose birth is unknown. He published *Essay on Harmony as it relates chiefly to Situation and Building*, 8vo., London, 1734; *The Art of Architecture*, a poem, 8vo., 1742; *An Enquiry after Virtue*, with an Appendix; *Rupert to Maria, an heroic epistle*, etc.; an *Essay on Design, including proposals for Erecting a Public Academy to be supported by Voluntary Subscription, till a Royal Foundation can be obtained, for Educating the British Youth in Drawing and the several Arts depending thereon*, 12mo., 1749; a small plan, with *Remarks on Sir C. Wren's mode of Rebuilding the City of London after the Fire*; and *Qualifications and Duty of a Surveyor*, in two letters, 8vo., 1752. In 1755, in conjunction with Samuel Wale, an engraver, he published a large plate of the *Transverse Section of S. Paul's Cathedral, decorated according to the original intention of Sir C. Wren*, engraved by E. Rooker; a reissue appeared in 1801 (a plan in two sheets of the cathedral, with the dimensions figured thereon, was published by them 26 June 1758). He was also in 1755 associated with others as a committee for carrying into effect the proposed "Royal Academy of London for the Improvement of Painting, Sculpture, and Architecture"; and about this time he declined the appointment of instructor in architecture to the prince of Wales, afterwards George III, but recommended William Chambers, then just returned from Italy, who received the appointment. In 1759 he submitted a design in competition for the proposed bridge at Blackfriars; that by R. Mylne was eventually carried out, after much controversy upon the question of using semicircular or elliptic arches, in which Gwynn was greatly assisted by Dr. Johnson, who wrote articles in his favour in the *Daily Gazetteer* of Dec. 1, 8, and 15. He next published *Thoughts on the Coronation of George III*, 8vo., 1761; and *London and Westminster Improved*, etc., 4to., 1766, the dedication to the king being written by Dr. Johnson; this work contains recommendations which have been largely carried out in later years: in this year he signed the Roll of the "Incorporated Society of Artists of Great Britain"; and in 1768, on the foundation of the "Royal Academy of Arts", he was nominated one of the first four architect academicians.

Besides several designs exhibited 1760-7 at the Incorporated Society's rooms, he in 1769 exhibited at the Royal Academy 'alterations of an old room in Shropshire'; and in the same year the first stone was laid June 29, of the New or English bridge over the river Severn at Shrewsbury; it consists of seven semicircular arches, the centre 60 ft. span and 35 ft. wide, the total length 410 ft.; it was completed 1774, at a cost of £10,794, or a total expenditure of £15,710; this design has been en-

graved. On the 27 July 1769 was laid the first stone of the bridge over the river Severn at Atcham, four miles below Shrewsbury, consisting of seven arches of less span and width than that just described. In 1770 he exhibited the 'Bridge to be built at Worcester over the river Severn'; it was commenced 25 July 1771, and consists of five semicircular arches, the centre 41 ft. span and 25 ft. wide, with the total length of 270 ft.; it was completed in 1780 or 1781; an engraving of it is given in NASH, *Worcestershire*, fol., London, 1782, ii, app. cxv. In 1771 he exhibited a "design to make Whitehall a part of the British Museum, by the addition of a centre piece opposite the Horse Guards": on the 14 May he was appointed surveyor to the new Board of Commissioners of the Paving Acts at Oxford; and subsequently made plans for pulling down the east and north gates, including the Bocardo or civic prison, widening the streets at that part, taking down the old Magdalen bridge and making new approaches thereto, etc.. On the 21 June his plan for the temporary bridges was approved and his salary fixed at "£150 per ann. for three years certain, and for one year more if necessary". He designed the new Magdalen bridge; on 17 Jan. 1772 a model was ordered to be made of half of it, at an expense not exceeding £60; the bridge was commenced under a contract for £6,979, but cost £8,200, and though not finished until 1782, it is probable that Gwynn was not employed after 1779. This work consists of two bridges over the two arms of the Cherwell, each having three semicircular arches and two for footways, extending about 110 ft., and connected by a causeway 200 ft. in length on the island, with a small archway in it; the bridge is 28 ft. wide, with a total length of 526 ft. For the same city he designed the workhouse, of stone, two stories in height, 237 ft. in length, at a cost of £4,030: and in 1773-4 the market, each portion of which was surrounded by a colonnade lately removed.

In December 1783 he was presented with the freedom of Worcester, in testimony of his merit in planning the bridge and the improvements to the approaches to that city, where he was residing at his death 27 February 1786; he was buried in the graveyard of S. Oswald's hospital, where tablets, now somewhat defaced, record his name and that of his only son, who died 10 (?) . . . 1796. A portrait of him by J. Zoffanij, R.A., is in the possession of Mr. H. Pidgeon of Shrewsbury. The bridge at Henley-on-Thames, and that at Tern near Atcham, sometimes attributed to Gwynn, were by Wm. Hayward, his assistant.

Many of Gwynn's drawings are preserved in the Royal Collection in the British Museum; further notices will be found in CHAMBERS, *Biog. Illust. of Worcestershire*, 8vo., Worcester, 1820, p. 504-6; SANDBY, *Hist. of the Royal Academy*, 8vo., London, 1862; BOSWELL, *Life of Dr. Johnson*, edit. by CROKER, 8vo., London, 1847, pp. 118, 122, 181, 424, 481, 483; MULVANY, *Life of Gandon*, 8vo., Dublin, 1846, p. 162; Sir J. HAWKINS, *Life of Dr. Johnson*, 8vo., London, 1787, p. 373-8; LITERARY GAZETTE for Feb. 11, 1826, and March 31, 1827; NASH, *Hist. of Worcester*, fol., London, 1782; CAMDEN, *Britannia*, edit. by GOUGH, fol., London, 1789, ii, 417; *MS. Communications*; which, with extracts from his Will, and others from the Minute Books of the Commissioners at Oxford, have been incorporated in a memoir given in the *BUILDER Journal*, 1862, xxi, 454-7; xxii, 27-8: a plan and elevation of the bridge and of the market, both at Oxford, to a small scale, are given in *The New Oxford Guide*, sixth edit. enlarged, 8vo. (1772). W. P.

GYMNASIUM (Gr. γυμνάσιον, derived through γυμνάζειν 'to train or exercise', from γυμνός, naked, or partly naked, or rather perhaps (in reference to the striplings concerned) wearing a shirt without any other outer garment, or even as wearing the χιτὼν, not being of age to assume the χλαμὺς). The name given to the place, whether covered or uncovered, appropriated for physical education and training, imported from Crete into Sparta and Athens, in its two branches, the agonistic or competitive, and the athletic or combative. It would seem that up

to the age of sixteen years the Greek youths found in the gymnasium the public school for gymnastics, music, grammar, and perhaps drawing; and during two years more for the gymnastic exercises, of leaping, throwing the quoit and the javelin, boxing, wrestling, and foot or chariot racing. This education was considered so important that, as noticed by PAUSANIAS, vii, 2, no one was placed on the roll of citizens at Pellene until he had completed it. Adults were excluded certainly until the sixth century B.C., when the gymnasia appear to have contained baths, and to have been frequented by persons deriving intellectual pleasure from listening to the teachers of philosophy, etc., and perhaps adults in general were so excluded until the fourth century B.C.; but afterwards the gymnasia became places of amusement, i.e. simply agonistic schools with spectators, such as the smaller gymnasia at Athens, which differed very little from palaestrae wherein persons of all ages assembled: in the course of time the prevalent laxity reduced the gymnasia to be merely athletic schools. It is worth while to notice that VITRUVIUS, v, 11, describes a gymnasium under the name of palaestra; and therefore some critics have held that there was no difference between the two: but they might have learnt from PLUTARCH, *Symposiacum*, ii, 4, that the palaestra was the place where the wrestlers exercised, and from PAUSANIAS, v, 15, that in the gymnasium at Elis there were the gymnasium proper, or course for running, and the palaestra, or sanded area for fighting. PALAESTRA.

Originally a clear flat space surrounded by a wall, afterwards divided into courts for the different masters, and shaded by alleys of palm-trees, the gymnasium grew into a vast place with porticoes and galleries (that of Hadrian at Athens had one hundred columns of Libyan marble), decorated with pictures and sculpture, and containing altars, statues, and monuments (the hermæ in the gymnasium of Ptolemy were considered admirable): PAUSANIAS, iv, 32, mentions Mercury, Hercules, and Theseus as the patrons of these establishments, of which the chief at Athens were the Akademia, the Kynosarges, and the Lukeion. At Olympia the stadium and the hippodrome were appurtenances of the gymnasium. Although, towards the end of the republican period, many a wealthy citizen at Rome had his private gymnasium, and although Nero and Commodus each built one for the public, yet these buildings seem to have had little importance in comparison with the amphitheatres and the thermæ: the latter, indeed, were apparently imitations of the gymnasium, consisting nearly of the same component parts, viz. places for different corporeal exercises, baths, and places adapted for public tuition by lectures or disputations: indeed ÆLFRICUS, *Gloss. Saxon.*, says "thermæ vel gymnasium; bæsthæde, locus lavacri." A treatise by D'AULISIO, *De Gymnasii Constructione*, 4to., Naples, 1694, may be consulted; and the question whether the ruins at Ephesus, like those at Alexandria Troas and Hierapolis, belong to gymnasia or to baths, is discussed by FALKENER, *Ephesus*, 8vo., London, 1860, pp. 71-101.

In the middle ages the word became applied to a monastery, as in 'gymnasium monasteriale ubi studium vitæ præsentis agonizando percurreret', and other phrases cited by DUFRESNE, *Gloss.*, s. v. At the present time the word has two separate meanings on the continent. In the first sense it is the distinctive name in Russia and Germany for what is termed a *collège* in France, being below the university and academy or seminary in rank; pupils from the elementary or parochial schools, and even from what are called in Holland the Latin schools, or district high schools, enter this *école savante* to receive a superior education and to learn its application in life: it is generally a school of four or five classes, and resembles in many respects the great public schools in England. The plan of such a building at Tcherkask is given by its architect RUSCA, *Recueil*, fol., S. Petersburg, 1810, pl. G 6. In the second sense it is the name for a place in which pupils are trained in gymnastic exercises, consisting of drill, dancing, fencing, rackets,

riding, swimming, and even rope-dancing (old Fr. *académie*; Ger. *turnhaus*): it is in this sense that the word is now used in England, whether applied to an uncovered place as at Primrose-hill (ILLUST. LOND. NEWS *Journal*, 1848, xii, 283); or to the building erected 1858 at Oxford; or to that commenced 1863, at a cost of £6,000, for the military at Chatham, the main building of which will be nearly 200 ft. long, and will include a school of arms 100 ft. long by 50 ft. wide, together with a separate gymnasium for more advanced proficient with a prepared soft floor of exactly the same dimensions, an officers' fencing room 50 ft. by 25 ft., together with dressing rooms and other convenient apartments for officers and men, and for the instructors. The *turnhaus* at Königsberg is given in the *BAUZEITUNG Journal*, 1846, pl. 71, p. 308.

The points which chiefly seem to have received attention in the German gymnastic clubhouse now (1864) erecting in the S. Pancras-road, London, are, sufficient height between the floors, whenever the building is more than one story high, and this should not be less than 15 ft. 6 ins. clear; a certain proportion of the building not less than 45 ft. high without obstructions of any kind, and with ready access from the grounds to all parts; proper accommodation, by means of galleries, for spectators; and above all, ample means of ventilation without draft, and which can readily be controlled by the attendant in charge; warming is of but very minor consequence. The large hall for gymnastic purposes is 84 ft. long by 80 ft. wide. E. A. G.

GYMNASTERIUM, see APODYTERIUM.

GYMNOCLADUS CANADENSIS, called 'coffee tree' from the seeds formerly used as a substitute for coffee; and 'hardy donduc'. A native tree of Kentucky, United States, giving a hard, compact, strong, and tough wood, of a fine rose colour, used by cabinetmakers and carpenters in America. It weighs 40 lbs. 7 ozs. per cubic foot. The tree has the property of rapidly converting its sap wood into heart wood, so that the smallest trees may be converted to useful purposes. In Tuscany it is called *albero morto*. 14. 71. 90.

The *Coffea Arabica*, coffee tree of British Guiana, is a very different tree growing only a few feet high; it is useful only for turning, having the appearance of box wood.

GYMOWE. A hinge; see GEMMEL.

GYN or GYN. A machine for raising weights which has three legs, each of 12 or 13 ft. long and 4 or 5 ins. diameter at bottom, and about 3½ ins. at the top; joined together at the top by a pin, forming a triangle when opened. The gyn is sometimes furnished with a windlass fixed between two of the legs and turned by handspikes. A gyn worked by horses is given in STRICKLAND, *Reports on Canals*, fol., Phil., 1826, p. 56. The term is noted as early as 1432, "the Duke to find all materials, ropes, bolts, scaffolds, gynnes", etc., in the contract for building the chapel at Fotheringay; and in 1487, "also for tymbre and estrich borde for gynnes and wyndowes, 0:2:4½"; NICHOLS, *Illustrations*, 4to., London, 1797, p. 97. DERRICK.

GYNÆCEIUM (Gr. *γυναικείον*), GYNÆCONITIS (Gr. *γυναικονίτις* or *γυναικονίτις*). The women's apartments or harem in a Greek house. The Greeks followed the customs of the Oriental nations in secluding their wives and daughters, and therefore these apartments were necessary portions of their houses. In Homeric times (*Iliad*, xvi, 184) they seem to have been placed in upper stories. From the description in VITRUVIUS, vi, 10, and from incidental notices, we gather that in after times they were on the same floor as those of the men. ANDRON. The communication was by a door called *μέσσωλος θύρα*, leading into a passage called *μεσάωλος τόπος*, SUIDAS s. v. *μεσάωλον*, and which passed from the peristyle of the men's apartments into that of the women. XENOPHON, (*Economics*, ix, 5, calls it *θύρα βαλανωρίς*, the bolted or fastened door, and says it was intended to prevent things being conveyed in which should not, and to hinder improper conduct. The women's peristyle seems to have been much like that of the men, except that on the fourth and preferably the north side there was not a colonnade.

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Round three sides were dining rooms, *triclinia*, sleeping rooms, *cubicula*, and small rooms for servants, *cellæ familiaricæ*. On the fourth side, instead of columns, were two *antæ*, making a sort of lobby, which VITRUVIUS calls *προστώς* or *παρυστός*, on the right and left of which were two larger chambers called the *θάλαμος* and *αντιθάλαμος*; in the former of which XENOPHON, (*Econom.*, ix, 3, says the valuables of the family were kept; and the latter probably was the bed chamber of the master of the house. Beyond these were large halls, *αἶθρὰ μεγάλα*, or spinning and weaving rooms, where the mistresses of the families held meetings (*sessiones*) with the wool workers. The roofs are said to have been flat; but this may be doubted, as XENOPHON (*loc. cit.*) says that food may be stowed in the dry parts of the roofs of the *θάλαμος*. AULA. A. A.

JULIUS POLLUX, i, 76, ix, 13, mentions another door, *κηπαία θύρα*, or door leading into a garden, which probably also led out of the gynæceum, as the garden would probably be the chief place of exercise for the women. In his preface, CORNELIUS NEROS clearly states that the Roman ladies occupied the front of the house, not the first floor, as some have translated his word 'primum locum ædium'. It is questionable whether any example of a perfect gynæceum can be traced in the remains at Pompeii, even in the cases of the house of Sallust and the villa of Diomedes. But ISIDORUS, xiv, 6, and after him PAPIAS, use the word *genecium* as equivalent to *textrina publica*; and consequent upon the use of the public *lanificium* as a house of correction, and upon the licence exercised by the owners of private factories, DE JANUA inverts the meanings, and explains *genecium* as *lupanar vel textrinum*.

The *hyperoia* and *catechumena* (*ὑπερβόα* or *κατηκούμενα* of the emperor Leo) are the gynæceum of PAULUS SILENTIARIUS, ii, 125, and the gynæconitis of PROCOPIUS, *De Edif.*, i, 1, applied to the places reserved in churches for the female portion of the congregation: these in the Eastern churches appear to have been triforia, and such were the *técassirs*, 'the between roofs' in the mosques according to GIRAULT DE PRANGÉY, *Essai sur l'Architecture des Arabes*, 8vo., Paris, 1841, p. 31, who notices that this system, inclusive of the separate entrance, is still in existence at S. Lorenzo and at Sta. Agnese at Rome; but in this latter the separate entrance is for the nuns. The andron and the gynæceum were respectively the south and north side of the church in the Western churches; but BINGHAM, *Origines*, 8vo., London, 1840, ii, 413, says it appears to have been otherwise anciently in many of the Greek churches; and that the custom in them was for the men to sit below, and the women in the galleries on the south or left side of the church, if not on the right also: the passages cited, however, have no regard to the question of ORIENTATION. The practice at Burgpfarrnbach near Nuremberg (WEBB, *Sketches*, 8vo., 1848, 102), and in the great parish church at Andernach, is different, for there the men occupy the galleries, the women sitting below: "in Poling church, and also in Arundel church, the seats are marked M and W respectively, according as they are assigned to men or women; . . . the women as they entered" (in Arundel church) "proceeded to those at the eastern end, which were left vacant for them, whilst the men by themselves occupied those at the western end", NOTES AND QUERIES *Journal*, July 1850: somewhat according to the dictates of the *Constit. Apost.*, ii, 57; but the tradition on the continent asserts that this is a Protestant innovation, ARCHÆOLOGIA, 1857, xxxvii, 129. "It has always been the custom to separate the men and the women in this church (Finedon), the men occupying the seats down either side of the nave, the women those in the aisles"; *Architectural Notices of the Churches of the Archdeaconry of Northampton*, 8vo., London, 1849, p. 139. HALLMANN, *History*, etc., in *Transactions of the Royal Institute of British Architects*, 4to., London, 1842, p. 100, states broadly that in the Russian churches there are no separate places for the women.

GYPSUM (It. *gesso*; Sp. *aljez*, derived through *algez* from

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the Arabic corruption of the Latin *gypsum*; the verb *alger*, *algezar*, or *alzir* implies 'to plaster'; Fr. *gypse*; Ger. *gips*). The name given by miners to the bihydrated sulphate of lime, found in large masses at Montmartre near Paris; generally in the county of Derby; and at various other places in the Old and New World. Gypsum occurs in the crystallized and in the amorphous state; when it is crystallized it assumes the form of an oblique prism, and cleaves with considerable ease in a direction parallel to the longitudinal axis. The specific gravity of pure gypsum is usually reckoned at 2.322; and its constituent parts seem to be sulphuric acid 46, lime 32, and water 21. The gypsum of commerce is largely used for the purposes of manufacturing plaster of Paris, and for sculpture. The stone employed for the former purpose is extracted, in England, from the quarries in the new red sandstone series, where it occurs associated with marl beds and salt rocks; it is sub-crystalline in its texture, and tolerably pure in its composition. The material used in France is principally obtained from the freshwater limestones of the tertiary series, and is said to contain a notable proportion of the carbonate of lime in combination with the sulphate. Whether it be owing to this presence of the carbonate of lime, or the superior hardness of the stone in the first instance, the French plaster of Paris sets more rapidly and much harder than the English; a fact which accounts for the prejudice that the English plasterers have always displayed against the introduction of the foreign article. There would, however, appear to be some reason for believing that the rapid setting of the French plaster might exercise some deleterious effect upon the subjacent coats of lime and hair used as the basis of English plastering.

Gypsum loses its water far below red heat, splitting into layers, and crumbling to a white powder. In the air, it begins to part with its water of crystallization at about 100°; and it becomes anhydrous at 132°. Gypsum deprived of its water at 132°, solidifies if water be again presented to it; but if it be exposed to a heat rising to 200°, the gypsum becomes over-burnt, and it then absorbs the water with the same amount of difficulty as the anhydrite. It follows, therefore, that the burning is not carried to any great extent; and for this reason the use of fire-wood is retained in the neighbourhood of Paris, and the London kilns are simply heated by reverberation: the beds of the Paris stone frequently differ greatly in their mechanical and chemical nature, and great care is required to obtain a resulting mixture which shall be uniform in its nature. In some cases in the neighbourhood of Paris the operation of dehydrizing the gypsum is performed by causing the gypsum to revolve in cylinders, in a powdered state, over an open fire, or by passing overheated steam over it.

Gypsum used for sculpture is obtained principally from Volterra and Castellana in Tuscany; and it is sought for on account of the whiteness and the translucence observable in it. This variety occurs in the grey and bluish marls known as the "mattajone", which belong to the subapennine varieties of the tertiary series, and are very much distorted by the geological disturbances of that region. It is very remarkable for the purity and mass of the formation, which is sold under the name of ALABASTER (BASTARD); though the alabaster of the ancients was a distinctly formed deposit of stalactitical carbonate of lime.

It is important to observe that gypsum dissolves in 460 parts of cold, and a little more of boiling, water; and for this reason it should never be employed in any structure exposed to the action of running water, either in its natural state or in its dehydrized state. The powder of unburnt gypsum also solidifies by mixture with the aqueous solution of potash, or of the various salts of potash. GMELIN, *Handbook of Chemistry*, 8vo., London, 1848, iii; BURNELL, *Peculiar and Distinctive Character of the Gypsum found near Paris, and its Preparation and Application as a Plaster*, read 5 April 1850 at the Royal In-

stitute of British Architects, and given in *CIVIL ENGINEER Journal*, xiii, 185.

G. R. B.

The admiration which MATHEW PARIS, *Hist.*, 1640, p. 900, chronicles was felt 1254 by the English king Henry III, when he at Paris 'consideravit elegantiam domorum quæ de gipso, videlicet plastro, fiunt in civitate Parisiaca' clearly shows that in his time the English timber houses were not plastered. DALY, in the *Revue Générale*, 1843, iv, 232, gives a note by JANNIARD explaining that the houses round Paris have damp ground floors on account of the rapid formation of saltpetre at the bottom of the walls built of gypsum-rubble and plaster. In addition to the above, it may be stated that BRAARD, *Minéralogie*, 8vo., Paris, 1821, ii, 103, notices that the pure gypsums, however they may vary in colour, fracture, or texture, effervesce very slightly (if at all), and make a plaster which is poorer than that of the gypsums which are alloyed with sand, clay, or calcareous earth, such as those of Montmartre, Mémilmontant, Mont Valérien, etc. These effervesce slightly, and make a hard plaster, that is used in France not only as mortar, but for running iron in masonry, and for external work, as well as for internal coats and moldings. He adds that the want of power in the plaster to absorb water proves that the gypsum has not been sufficiently baked; and that the refusal of the plaster, when mixed with water, to stick to the finger, shows that the plaster is too poor, and proves that the gypsum has been too much baked, for in this case the powder becomes almost vitrified. He notices that selenite or crystallized gypsum makes a plaster which takes too quickly, so that molders use the *roussette* from Montmartre and Bagnolet, costing three times the price of common plaster, which sells at 40 centimes the bag of 5 lbs. French. If plaster of Paris be permitted to absorb damp air, it will not set when it is mixed: and BRAARD notices, in the operation of mixing, the following points: it takes a volume of water equal to itself; it swells in consequence of a rapid and confused crystallization; and it rises considerably in temperature. He considers the plaster to be the *chunam* of India, and the *guetch* (GUEESH) of Persia, where its expense formed a third of the total cost of a mansion; and does not fail to remind the reader that although a joint of plaster between two bricks is at first a third stronger than one of mortar, yet this superiority is reversed in time. It is stated by LIEBIG, *Annalen*, as cited in the *CIVIL ENGINEER Journal*, 1848, xi, 288, that calcined gypsum, after being moistened with a solution of alum and again burnt, acquires greater hardness and solidity; for the same purpose KREATING recommended 1 lb. borax and 9 lbs. water; the effect is said to be better if 1 lb. tartar and twice the quantity of water are added to the solution: KEENE'S, MARTIN'S, and PARIAN, CEMENT.

It may be added that in England plaster of Paris is never used as a mortar except for setting chimneypieces, nor employed externally for any purpose even under paint. The reason for this exclusion is that it is liable to a sort of decomposition: this, if it takes place under cover, would seem to be due to the absorption of damp air (in Lord Northwick's gallery at Cheltenham, the fine collection of statues, which were casts from the gallery of the Vatican, stood apparently secure until the attempt to remove them showed that they had no consistency). If the plaster be well painted, and exposed to the weather where any surface can be made wet, it scales and vermiculates on the surface almost more than if it had been exposed without paint. The quality in gypsum of increasing in bulk until it has set, which is so valuable where molds have to be filled, is extremely dangerous in the case of confined spaces or large surfaces, such as plaster floors, which require a wide margin to be left for the expansion. GWILT, *Encyc.*, p. 1017.

The plaster earth found in Glipston quarry, Northamptonshire, is a dry, harsh, gritty, light yellow powder, which adheres to the tongue but not to the fingers, and, mixed with water, immediately sets without previous heating. 2.

GERBIER

ON THE

THREE CHIEF PRINCIPLES OF MAGNIFICENT BUILDING.

SIR BALTHAZAR GERBIER, BARON D'OUVILLY, has been very much undervalued by the compilers of Biographical Dictionaries, of whom not one appears to have consulted the account which he gives of himself, in the pamphlet entitled "BALTHAZAR GERBIER, KNIGHT, *to all men that love truth*" (dated, in a MS. note, *Paris*, 26 May, 1646), from which it appears that he was a child of Huguenot refugees—Antoine Gerbier, a gentleman by birth, possessed of a barony in Normandy, and Radegonde, daughter and heir to the Lord of Blavet, in Picardy.

He was born at Middleburg, in Zealand, about the year 1591; was educated, by his brother's means, in France; and returned to Holland in time to accompany Caron, the Dutch ambassador, to England. There he made his attendance pleasing to the famous George Villiers, on account of his "several languages, good hand in writing, and skill in sciences,—as mathematics, architecture, drawing, painting, contriving of scenes, masques, and entertainments for great princes; besides many secrets gathered from divers rare persons; as likewise for making of engines useful in war."

SANDERSON (*Grophice*, p. 15) calls him "a common penman, who pencilled the Decalogue in the Dutch Church, London, his first rise of preferment." Gerbier himself states, "the Duke of Buckingham put to me first, the contrivance of some of his habitations, and to choose for him rarities, books, medals, marble statues, and pictures in great store; I kept his cyphers with his intelligencers abroad, and was sent by him (with the King his master's approbation) on secret messages."

His services on one of these occasions were required by the Duchess, who in one of her letters (*Harl. MSS.* 6989) to her husband, at Madrid, 16th July, 1623, wishes him, that she might have it well done, to sit for his portrait, in little, to Gerbier, who had followed him in quality of painter in distemper, and had executed a miniature of the Infanta for King James.

His public employments abroad, were, his journey into Holland, to receive overtures for the restoration of the Palatinate; a mission to expostulate with Richelieu, on the behaviour of the French cabinet with respect to Count Mansfeldt; a conference with the Marquis Spinola, in Brabant, "on which the treaty with Spain was set on foot, and pursued until it was brought to a conclusion"; and to remonstrate at Paris, on the carriage of Spanish goods in French vessels. When Blinville, the ambassador, had contrived to excite a riot in London, Gerbier was ordered to make a drawing of the locality in which it occurred, to enable Buckingham to explain the matter to his master, by whom Gerbier was again sent to the French court. He then delivered to Richelieu that letter from the Duke, which is unnoticed in the history of our country, but was probably the most important document of the period, because the two favourites then declared their opinions of each other, which were so violently expressed by the cardinal, that to revenge himself, for the necessity of making an apologetical oration, he instigated and fomented those parliamentary troubles for Buckingham, which ended as fatally for the King.

WALPOLE (*Anecdotes of Painting*, vol. ii) gives a copy of one of Gerbier's letters, dated from the Hague, 6th August, 1627, in which Rubens's name appears as appointed to meet him on the subject of the Spanish treaty.

Buckingham desired that the feast of reconciliation between himself and the Abbé d'Escailles (della Scaglia), should take place at Gerbier's house, "where the Duke was pleased two days after, to beseech his Majesty to come with the Queen to accept like entertainment, because the manner thereof was pleasing." This supper is mentioned in a letter of 1628, as taking place at the Duke's painter's house, and was supposed to have cost a thousand pounds. He was knighted, 31st March, 1629, at Greenwich, probably on occasion of being made Master of the Ceremonies, and for eleven years after was resident at the court of Brussels, acting the part of an accomplished minister, as it was then played; as witness the reply, "it is not my custom to disgrace those that do serve me well", made to an address of the Spanish embassy for his removal, by Charles I, who seems to have had a great esteem for his works, as well as for his other services; this may be inferred from the letters of the King, and from the consideration, that such a connoisseur would not have insulted the talents of Rubens and Vandyke, by joining them in the same honor with a man of inconsiderable talent.

In 1637, he was sent on a mission to the discontented Duc d'Orleans: and on the 13th of July, 1641, he took the oaths of allegiance and supremacy, having obtained a bill of naturalization; but this watchfulness was not sufficient to protect him from being troubled in the following year by the populace, as a papist and concealer of priests; this seems to have driven him abroad; and going from the Hague, in 1645, he received from Charles a letter of credence to the French King, containing the following passage:—"I do recommend this gentleman, master of my ceremonies, to your particular protection, for that he hath done me long and faithful service." This was answered by a gift, in consideration of his detection, when at Brussels, of a plot on the part of the Duc de Bouillon, against the King's life. He says, that he received the superintendence of an office, which would have proved worth many thousand pounds a year, but that he was pursued by a faction, who maintained, in petitions presented by the Bishop du Puis to the Queen Regent, that she was, *ipso facto*, excommunicated, for bestowing such an office upon a heretic.

He lost his post; and the best light of his character is displayed in his efforts to obtain the return to his own care, of three daughters who were induced to conform to the Church of Rome, placed in a nunnery, declared to belong to others, and refused permission to have an interview with him.

Returning to his house in Bethnal-Green, he opened an academy, in imitation of the Museum Minervæ, of which he put forth an account, having his portrait in an oval, prefixed. Public lectures, of which nine are printed, were given on Wednesdays, until March 1650, as appears by his advertisements; in one of which, he professes to lend "from one shilling to six, gratis, to such as are in extreme need, and have not wherewithal to endeavour their subsistence, whereas, week by week, they may drive on some trade."

The publication by him of some well-intended pamphlets, shows, that he did not quit England until after 1652, when (having previously obtained a grant, during his residence at Brussels and the Hague, to settle in Cayenne) he went to Surinam; there, however (7th May, 1660), by permission of the Dutch governor, his house was broken open, the assailants killing his daughter Catherine, and endangering the lives of others, his papers seized, and he himself, menaced with a loaded pistol held to his head, unable to resist, was, with his family, put on board a vessel bound for Holland. On his arrival there, he complained, but obtained no redress; the States disowning both the act, and any pretended orders for it. As this happened immediately before the Restoration, they apprehended, knowing his obligations to England, that he might give notice of the advantages to be gained in Surinam.

This, in effect, was his revenge; his publications had a share in rousing Charles II to declare war with the Dutch; having no other recompense for his sufferings, after a life of many vicissitudes, he ended as he began, by the exercise of his professional skill; first, as asserted by Gough (*British Topography*, vol. i), in designing the four triumphal arches for the coronation procession at the Restoration; and afterward, on the erection of the Lord Craven's house at Hempstead-Marshall, in Berkshire, since destroyed by fire. Representations of the arches are given by OGILBY (*The Entertainment, etc., of Charles II*, fol. Lond. 1662). In the *Britannia Illustrata*, fol. Lond. 1714-20, pl. 45, is a view of Hempstead-Marshall. Excepting two printed essays, this was Gerbier's last production; for while it was building, he died there, in 1667, and was buried in the chancel of that church. The two publications are, in reality, but one work: the second portion, entitled "*Counsel and Advice to all Builders*", 12mo. Lond. 1663, has been so recently subjected to the attention of the profession, that it does not appear necessary to say more of it, than, except where it gives the prices of the materials, and of the workmanship of that time, it is inferior in interest to the following treatise, which is remarkable, not only for being one of the few early English publications on the art, but for being evidently the fruits of many conversations, held both with professional men and with amateurs, by one who himself understood the practice and theory of the art as an Architect, and at the same time, by a rare concurrence of events, was enabled, like Lord Burlington, by birth, education, and position, to comprehend the requisite points of buildings for the most refined courts of a luxurious age. The word "Builder", is applied by him to the building owner; and, in his use of the terms, Surveyor and Architect seem to be synonymous.

The promise of the reversion of Inigo Jones's post, mentioned in the following preface, does not seem to have been inconsiderately made; the arches and Hempstead-Marshall are not "horribly ugly", and may serve as very fair specimens of the taste of their day. In that view they are by no means discreditable in design, though not precisely ranking in purity of detail, with the best works of such classes of composition. With this reservation, then, those who wish to consult an account of the letters, productions, portraits, and other curious particulars of himself and his family, may refer to the *Anecdotes of Painting*, vol. ii, 8vo. Lond. 1826, pp. 114-126; but it is due to our author to note, that *George d'Ouvilly* therein mentioned, as a misprint for Gerbier d'Ouvilly, is the same as Captain *George Gerbier d'Ouvilly*, of the city of London, Esquire, "oltramamento detto Giorgio di San Giorgio di Vinegia"; and *Antoine* is also mentioned by the bibliopoles of France, where Balthazar published a work on Fortification. In the British Museum are copies of twenty-four of his works, published in England, several of which have passed through two editions.

A Brief
DISCOURSE
 Concerning the
THREE CHIEF PRINCIPLES
 OF
MAGNIFICENT BUILDING ;

viz. { *Solidity,*
Conveniency,
and
Ornament.

By *Sir Balthazar Gerbier D'Ouvilly*, Knight.

LONDON,
 (First) Printed in the Year 1662 (and again in 1664).

TO THE KING'S MOST EXCELLENT MAJESTY.

May it please your Sacred Majesty,—

MY place of Master of the Ceremonies (which the King, your royal father, of blessed memory, confirmed unto me during my life, by the great seal of England), is to introduce foreign princes, or their public representatives, to your sacred presence. And in regard the place of Surveyor-General, was also intended to me (after the late Inigo Jones), I do make bold to introduce the three capital principles of good building to your Sacred Majesty, who hath seen more stately palaces and buildings than all your ancestors; and may be a pattern to all future posterity, by building of your own palace worthy yourself, and placing it, as

the Italians, for their health, delight, and conveniency (as well as solidity and ornament), "*La matina alli monti, la sera alli fontì,*" according to which, the main body of your royal palace may be set on the side of Saint James's park, and the gardens along the river.

If the book afford any thing worthy your Sacred Majesty's further satisfaction, I have obtained my end, and done the duty intended by, Your Sacred Majesty's

Most humble, most obedient, most loyal subject,
 and most zealous servant,

BALHAZAR GERBIER D'OUVILLY, Knight.

TO THE LORDS AND COMMONS ASSEMBLED IN PARLIAMENT.

May it please your Honours,—

IT being lately reported that your Honours have deliberated to have the streets made clean, to enlarge some of them, and to build a sumptuous gate at Temple Bar, I thought it my duty to present this small discourse of the three principles of good building; and, withal, a printed paper, concerning the cleaning of the streets, the levelling the valley at Fleet Bridge, with

Fleet-street, and Cheapside; and the making of a sumptuous gate at Temple Bar, whereof a draught hath been presented to his Sacred Majesty, and is ready also to be produced to your Honours, upon command, with all the devotion of

Your Honours'

Most humble and most obedient servant,

B. GERBIER D'OUVILLY, Knight.

A BRIEF DISCOURSE CONCERNING THE THREE CHIEF PRINCIPLES OF MAGNIFICENT BUILDING: viz., SOLIDITY, CONVENIENCY, AND ORNAMENT.

WHEREAS building is much minded in these times, I thought fit to publish some principles thereon, which may stand the lovers of it in stead; yet without spending time and paper to note how a point, line, angle, demi-circle, cube, plinth, base, pedestal, column, head, architrave, frieze, cornice, or frontispiece must be made; and what dimensions all those several parts (a point excepted) must have, since all master-workmen ought to remember (as scholars their grammar, and arithmeticians their table) how every particle must have its just proportion; and that the height of windows and doors must be double their breadth; and, also, to be careful to maintain the due esteem of their art, since its dimensions and rules came directly from heaven, when the great Architect and Surveyor of heaven and earth prescribed the rules and particular orders for the building of a floating palace (Noah's ark), and the glorious, matchless temple of Solomon, the perfect house of prayer.

ARCH. PUB. SOC.

And, therefore, such precedents may serve to convince those who say, that a wise man never ought to put his finger into mortar, since there is a necessity for building, especially among nations who do not, or cannot, live in caves and hollow trees, or, as the wild Indians, who have no other roofs but of palmito-leaves; nor wainscot, but bamboos, as they call the poles to which they tie a woollen hammock to lie in.

There are three capital points to be observed by men who intend to build well; viz., Solidity, Conveniency, Ornament.

Those who have marshalled the orders of columns (to make good the first point), have ranged the Tuscan to be the supporter of a building; but such an atlas must stand on a firm ground, not as ill builders place columns (either of brick or stone), like things patched or glued against a wall, and, for the most part, against the second story of a building (contrary to the very Gothic custom, who, at least, did begin their buttresses from the

ground), as if their intent were, that the weight of the columns should draw down the wall on the heads of those that pass by.

Such builders confound the first and essential point of building (to wit, solidity,) with ornament and convenience.

They will make a show of something, but miss thereby (as ill bowmen) the mark. They may, perchance, have heard of rare buildings, nay, seen the books of the Italian Architects, have the traditions of Vignola in their pockets, and have heard lectures on the art of architecture, which have laid before them the most necessary rules, as, also, the origin of the several orders of columns, and discourses made thereon; that the Tuscan is as the Hercules; so of the Ionic and Corinthian; the first of the two, to resemble the dressing of the daughters of Ionia, who had twists of hair on both sides of their cheeks. The Corinthian heads, to represent a basket with acanthus leaves, and the guttered columns, the plaits of daughters' and women's clothes.

That the Grecians (in remembrance of their victories) did range the columns in their buildings, to represent the number of slaves which they had taken; the grains, beads, drops, pendants, garlands, interlaced knots, fruitage, and an infinite number of ornaments which are put on the frieze, to signify the spoils which the victors had brought away from their enemies; and, to preserve the memory thereof, did place them on their buildings, that they might also serve for a true history.

But none of such ornaments were ever impediments to the strength or convenience of a building; for they were so handsomely and well contrived, as once the Duchess of Chevr  se (a French lady) said of the English females, that they had a singular grace to set their ornaments right and handsomely.

The barbarians and naked Tapoyers, Caripowis, Alibis (and several Charibdiens) do place pendants in their nostrils, which are proper for their ears; and these hinder not the use of the lips, which ought to be observed by all builders.

As for the inside of fabrics, builders should, in the first place, set the doors, chimneys, and windows, as may be most convenient for use.

Builders ought to be not only experimented in housekeeping, but also good naturalists; to know (before they spend time and materials) the required property to every part of a building. A door to be so set, as it may not convey the wind toward the chimney or bedstead, though opened never so little.

The windows to be so placed, as that the fire made in the chimney may not attract the air and moisture, and so prove the unwholesomest part of the room for those that are near the fire; which was the main reason why the great Isabella, Infanta of Spain (King Philip the second's daughter, who governed the provinces of Brabant, Flanders, Artois, and Hainault, during her many years' residence at Brussels), being prepossessed with a prejudice, never approached a fire to warm herself; till at last, being thoroughly wet (going a procession in a great rain, and by a visit made by Mary of Medicis, Queen-Mother to Lewis XIII, just as she had returned to her palace had no time to shift her), she was constrained to approach the fire to dry herself, and a few days after, she fell sick and died upon it; which relation being very true, and happening in the time that I resided for the King of blessed memory in that court, I thought fit to mention, to persuade all noble and curious builders to place their doors, windows, and chimneys in their proper places.

And though it be not my design, in this small discourse, to treat of dimensions (which are fit for a primer to apprentices), yet I cannot desist (by reason of the West Indian hurricane-like winds which happened February last) to persuade all builders to forbear the building any more those exorbitant chimney-shafts, which, when they fall, break both roofs and ceilings of rooms, and kill good people in their beds; since a chimney some two feet higher than the ridges of the roof of a building (which is not overtopped by a church or steeple, or some other eminence), is as good a conveyance for the smoke, as any of a greater height. Neither are those high shafts of chimneys real ornaments to a building, much less to the palace of a sovereign; nor do the

German travellers of this age, any more fill (as formerly) their table books with the number of them, as they were very careful to note the names of their hosts, where the best wine was, and when they tasted that called *lacryma Christi*, they moaned, and asked why He did not weep in their country. It is true, that the least addicted to bibbing, did put in their stem-books the dimensions of the Pantheon, and of the amphitheatres; as also of Caprarola, Frescati, and such magnificent structures above ground in Italy; and, under-ground, La Piscina Admirabile, La Grotta de la Sibilla Cumana, Bagni de Cicerone, Cente Camere, and le Sepulture de li nobili Antichi. But they are now taught by tutors to observe the inside of men and buildings. And as the best ornaments of a face, appear at first sight by the eyes, mouth, and nose; so do the best qualities of a perfect building, by windows, and doors well placed, as also by a large, magnificent, commodious, and well-set staircase.

Noble, magnificent, and commodious staircases, must in the first place participate of a nobleman's manner of pace and attendance.

There is no man of sound limb (and that hath a gallant gait), but lifts his toes at least four inches, when he goeth an ordinary easy pace; so that if two steps (each four inches high) be eighteen inches broad, or deep, which makes six-and-thirty inches the two, (the just measure of a man's two steps), they may be ascended, from the first floor, to the higher story, as if a man walked on a level ground.

Secondly. Those stairs ought to be so long, that the attendants on each side the noble person, prince or sovereign, may not be straitened for room.

Such were the monarch-like stairs of the Palace of Darius, and Cyrus the Great, at Chelminar, in Persia, near Saras, the metropolitan, between Ormus and Espahan. I do speak indeed, of a palace without comparison to any other; the walls of circumvallation of that palace, being four-and-twenty foot thick, and the stairs (as yet in *esse*), are forty foot long, in number a hundred and eight, of circular form, and of so easy an access, as that travellers do ascend them on horseback.

King James of blessed memory, could not have been so much in danger of an onset, in a pair of stairs large enough for a noble retinue to his person, as he was in a narrow pair, which history mentions.

Neither had William, Prince of Orange, been so easily shot, at Delft, in Holland, descending a narrow pair of stairs.

Thirdly. A noble pair of stairs should have a cupola, and no windows on the sides, which for the most part serve but for rude and unadvised men to break.

In some palaces and noblemen's houses, "Too many stairs and back-doors, (as the old English proverb) make thieves and whores." And the setting the front of a building towards the north-west, and a palace, like Cardinal Wolsey's ill-placed one, (now called Whitehall) on a low ground by the river-side, makes work for physicians, apothecaries, surgeons, coffin, and grave-makers.

But as for a seat on moorish grounds, except the builders observe the practice of those of Venice in Italy, and Amsterdam in Holland, who bestow more timber of oak, in the foundation of one, than in the building of six houses, in effect, it is to build perpetually, leaving to their posterity to prop and redress their ill-grounded buildings; and they may well be ranked with the Duke of Arscot, who built much in Brabant, and, (in a merry humour) designed in his will ten thousand gilders per annum, to support and alter what he had built amiss.

I must also advise builders on high grounds, to cause their Surveyors to search for springs, and shun them; which serve better to fill up glasses to allay the vapours of Gascony wines, than to make a pond in a cellar.

Builders ought also to be very curious and careful in the choice of the place to build a seat on, for good prospect, well garnished with woods, and the water at hand, not too near nor too far from a city, or town.

Item, I must wish all princes and noble persons, who are resolved to build palaces and seats answerable to their quality, to imitate those who in the heathen age were so careful in the ordering of the structure of their stone images, especially of their Saturn, Jupiter, Apollo, Mars, Neptune, and all their fry of wanton Goddesses, as to empanel a jury of philosophers, naturalists, physiognomists, and anatomists, who were to direct the sculptors how to represent those images. And so I would wish builders to proceed, in the contriving the models of their intended fabric, to wit, to consult (as those of Amsterdam did in the making the model of their town-house) divers experimental Architects, though they pitched, for the front, on the worst of all.

Item, before the workmen make use of materials, and not to build at random, as the custom of too many ill builders is; and when once the model is approved, never to alter, nor to pull down what has been well begun, nor to hearken to the diversity of opinions, which have been, and are the causes of many deformities and extravagancies in buildings; and especially those who seem to have had for models, bird-cages, to jump from one room into the other by steps and tressels, to cause men and women to stumble.

And the sides all of glass, like spectacles; the glass windows of small panes, with great store of lead, to draw the more wind and moisture, from the open air, within doors. As also windows with store of iron casements, which rust, and never shut close, notwithstanding all the various devices of smiths, to catch money out of the builders' purses, contrary to the good custom in Italy, Spain, France, Germany, and the Low Countries, which certainly for plurality of voices should be believed and followed.

Those nations cause their glass windows to be fitted in wooden casements treble riveted (rebated), to keep out wind and rain; they are lined with wooden shutters, and have double-boarded shutters without, to resist all the violence of the weather and thieves.

Let no man mistake these windows for wooden casements, for such [as] are usually seen here in England in old wooden houses, the casements scarcely above one foot and a half high, tottering things; for these are substantially, strongly, and curiously made casements; nor are the wooden shutters such paste-board like things, as are generally put on the outside of the windows, on the London and suburbs houses, but double-deal well-riveted windows, with substantial locks, bolts, and hinges, and a double iron bar, with a bolt fixed in the middle of them both.

Nor do good builders affect partitions of lime and hair in their houses, nor any of their bricks to be daubed over with finishing mortar.

The Romans are very curious in the tempering their mortar, and in the laying it as thin as possibly they can, to prevent the sinking and bending of their walls, which the laying of the mortar too thick does cause; and experience shews, that when some walls are taken down in England, half of the substance is sand and dust.

The Romans, as likewise the Grecians before them, did not make use of their lime at the same time it was slaked, but for six months time suffered to putrefy, and so putrefied composed a cement, which joined with stone, or brick, made an inseparable union, and such strong work, as I have seen iron tools break on the old mortar of the amphitheatres at Verona and Rome.

Their manner of preparing lime, is to lay it in cisterns, the one higher than the other, that the water (after it has been so stirred as that it is well mixed and thoroughly liquid) may drain from one cistern to the other; and, after six months time the lime (having evacuated its putrefaction), remains purified, and then they mix two parts of lime with one part of sand, and make that strong and pure mortar, which, if practised in England, would make a wondrous strong union, especially if the clay-makers did beat the clay as it ought to be, the English clay being better than the Italian, nay, the best in the world.

They are very careful in the making large and deep founda-

tions, and to let the walls raised on the foundations, rest and settle a good while, before they proceed to the second story.

Some of our carpenters have learned to lay boards loose for a time; the Italians, and other nations, are not sparing therein; they nail them, as if for good and all, but rip or take them up again, to fit them for the second time.

As I said before, no building is begun before a mature resolve on a complete finished model of the entire design. The builder, having made choice of his Surveyor, and committed to him all the care and guidance of the work, never changes on the various opinions of other men, for they are unlimited, because every man's conceits are answerable to their profession and particular occasion. A sovereign, or any other landlord, is then guided by natural principles, as well as by his own resolve, taken on a long-considered model, because they know, by experience, how sudden changes are able to cause monstrous effects.

They know that a well-experienced Surveyor must not be disturbed in his task and undertaking; but, as the silk-worm and the soul of man, the first in his husk, the second in the womb, wherein both the one and the other (by the powers of the great Architect and Director of all things) works out his own complete fabric, if not interrupted, but if interrupted by any outward accident, it happens that those passions become the original causes of exorbitant features and forms; an item for all builders to suffer a good Architect quietly to pursue his task, if he understand it.

It has been observed among the French (a nation as much addicted to changes as any), that, when the charge of an undertaking has been committed to many, it caused but confusion; and therefore it is a saying among them, "*Trop de cuisiniers gâtent le potage*," too many cooks spoil the broth.

I shall not spend time, and transgress on the reader's patience, concerning the making of clay, and burning of bricks, only say, that it imports much the clay should be well wrought before it is put in the mould. Experience has also taught brickmakers to have them of such a length, thickness, and wideness, that four of them (together with the mortar thereunto belonging) may raise a foot.

As for free-stone, Portland stone works well, and makes a good union with bricks, yet cannot be compared with marble, nor with the bluish stone of the quarries of Liège and Namur. But it is also certain that this climate makes marble itself to moulder very much; as, for example, the Cain and Abel in York House garden, which did not moulder when it stood in that of the duke of Lerma, at Valladolid, in Spain; the coldness, together with the moistness, of this clime being of a contrary operation to the temper of the air in Italy and Spain. And therefore, when builders see their copings, water-table, cornices, rails, and balusters, to decay, they must have patience, since there is no material but is subject thereunto; and that rails and balusters (either on the top of the walls of a frontispiece, or in balconies), though never so well painted in oil, and of the best-seasoned timber, but must be renewed at forty or fifty years' end.

Builders ought to calculate the charges of their designed building, and especially with what sum of money they are willing to part; and yet remember to imitate some philosophical humorist, who resolves to venture on a pretty thing called a handsome lady, without which their fate seems to tell them they cannot live; and therefore makes an account beforehand, that all things will not precisely answer his expectation. But, on the contrary, the lady, instead of being a good housewife, and an assistant, proves expensive, and an impediment. And if it prove otherwise, he will be a great gainer by the bargain; for let builders put their design to master-workmen by the great, or have it wrought by the day, either the workmen will overreach themselves, or the builder will be overreached.

Charity to the one, and respect to the other, moves me to keep the rest in my pen, yet shall never be backward to inform either of them, in the ear, what may be the best for them to choose.

But I must freely advise all builders in general, never to begin to build on a ground before it is purchased, as the late duke of Buckingham did at York House, where there has been much daubing and breaking through old, rotten, decayed walls; first, to make a ladies' closet on the corner of a wall where a buttress stood, and which was taken away for the closet, intended only at first for a closet of ease, and to serve until the archbishop of York could be persuaded to accept as good a seat as that was, in lieu of the same; which could not be so soon compassed, as the duke of Buckingham had occasion to make use of rooms, to entertain (according to the dignity of a prime minister of state) foreign princes and ambassadors: so as, on a sudden, all the buttresses that upheld that rotten wall were thrown down, the ceilings of rooms supported by iron bolts, balconies clapped up in the old wall, daubed over with finishing mortar, and all this (as a toad-stool grows in a night) to serve until a model for a solid building to stand even with the street were made, and to be built of such stone as the portico, or water-gate, at the river-side is; and this was done on a moorish ground, whereon no new building could stand any time without proppings, which was contrary to the main principle of good building.

I must proceed, and conclude, with my humble respects, concerning palaces of sovereign princes, which must differ as much from other buildings, as their quality and condition from that of their subjects.

And in the first place, as solidity must be the first principle in all good building, so much more ought it to be observed in that of sovereigns, unto whom the whole world has access.

And as there must be spacious ground before their palaces, their inner-court ample, the offices for their retinue large, and commodious, and so placed as they may neither be an annoyance, nor of ill aspect; the first stories ought rather to be vaulted than boarded, to prevent such an accident as happened to Louis XIII, French King and his Queen at a ball, when the floor of the room, with all the company, fell down; the King and Queen only remaining, (by a special Providence) on the hearth of the chimney, sitting under the cloth of state.

And as there is a necessary magnificence to be expressed on the front and inside of princely buildings, answerable to their greatness, so is it absolutely necessary that the Architect be possessed with a soul as great as the player in the French play called *The Visionaries*, where he persuades himself to be Alexander, and governs his motions accordingly. And the lines and strokes of the Architect must be Alexander-like:—his figures and statues, colossi; his pyramids like those of Egypt; and the vaults like that rock wherein Alexander and Darius wrestle for mastery, in a valley in Persia, between Babylon and Ispahan, at a place called Carimonshahan, where formerly was a great city, six English miles long; in which grotto, the Alexander-like mind of the sculptor hath hewn within the rock (besides Alexander on horseback, and a number of huntsmen and ladies) the aforesaid Alexander and Darius wrestling to break a ring between them.

Such a like mind Prince Thomas of Savoy (son to the great Emanuel of Savoy), infused into his Architect, sculptors, and carver in brass, whom he employed in the designing and building a stable, in Turin, within all of marble, the racks, manger, and the upright-posts all of copper, richly wrought, conveyances of water pipes. The manger fourteen inches wide at the bottom, to contain a pail of water on all occasions. The uppermost edge of the manger, three foot eight inches high from the ground, to accustom the Neapolitan great saddle-horses to raise their necks. The rack-poles three inches asunder, and upright, that as the Frenchman saith, *L'appétit vient en mangeant*, the horses may feed more cheerfully, the hay and dust may not fall on their heads, as it doth out of a rack which stands shelving: the under part of the manger ought to be made up, to keep in their litters, and no boxes made there for dogs, as some not curious do: where harnesses, saddles, coverings of horses, or

any other implements or tools, are not to be seen about the postern, since those things do but impede the access of a cavalier to the horses.

The disposing a stable into a double range, has been affected by some, who would see all their horses at once.

Others love only a single range with a broad walk, and if they have a great number of horses, return at the end into another range, if the ground can afford the same, so as a wall makes the partition between the horses.

The paving of such a stable is very neat, being of white or yellow (twice burnt) Flanders bricks, in Dutch called *clinkart*, far beyond planking of stables, for divers reasons. The paviers (after the bricks are laid) throw sharp sand over them, and twice a day they are watered with a gardener's watering-pot, and swept with a broom, which the grooms are to continue sometime, because the sand gets between the joints, and makes the paving very close and firm. The pavement at the foot of the manger, must be raised at the least six inches higher, than at the gutter where the posts are placed, which ought to be five foot and a half distant one from the other, which ground so paved is of double use; first, that the higher a horse stands towards the manger, the better sight it is, and especially when the lights of the stable strike on the horses' backs, which is the better light.

Secondly:—That a horse's usual standing place being so much shelving, accustoms the horse (reposing more on his hinder feet than on the foremost), to be more light and nimble in his gait and pace.

Thirdly:—That his stale do not remain under him, and especially when his standing has eight foot in length from the manger to the channel, which for neatness ought to be above ground, the eight foot in length being at full the space which the horse possesses, when in the night time he lies stretched on his litter.

I must not omit, by way of queries, to write somewhat concerning the kitchen of a princely palace; viz:—whether there should not be as much curiosity, if not more, in the kitchen than in the stable; since the meat prepared in a kitchen ought to be drest with all neatness, and preferred before a fine lace about the master cook's towel: neither are the vessels of silver but in reference to the neatness which ought to be observed in all cookery. The Frenchman's glass is wrenched [rinsed] as often as he drinks, and why should not cooks be more curious and neat in their kitchens, than grooms in their stables? And as a stable can have conveyances for the horses' water, so may kitchens for slabbering, for guts of fowls and deer, coals, ashes, and whatsoever else can cause dirt and nastiness, and be freed from the annoyance of smoke, which many ill-placed doors cause; nor ought the kitchen or other offices and cellars, (as in some palaces in France), to be so placed as they may prove prejudicial to the Court; and if they are underneath a palace they ought to be vaulted.

I must not forget that the roof of a palace should be covered either with lead or blue slates.

The Pantheon at Rome was covered with brass, which a pope melted to cast cannons, not such (*canons*) as only eat, drink, and sing.

No curious eye can well endure those barn-like roofs of many noble persons' palaces, covered with red tiles, which break and rot away, and then the roof being mended and patched, seems to be a beggar's mantle, which I would not have the nobles' and courtiers' to be. See the roofs of Leicester, Newport, Southampton, and such like palaces, whether they do not look as barns for hay, and piebald, by their patched tiles?

As for the main bulk of palaces, it is true some have a greatness in plainness, as that of Farnese in Rome, whereof Michael Angelo made the architrave, frieze and cornice.

And, as for bigness and solidity, that of S. Hieronimo, and the Escorial in Spain; for ornament, that of Munich in Bavaria; the Louvre at Paris for vastness, situation, and ornament; by the embossed imagery on the frontispiece, variety of

orders of columns, with the delight of the annexed Tuilleries, wherein, as especially in that of the palace of the Duke of Orleans, but above all, in the Cardinal Vigna's in Rome, is observed the form of a true princely garden,—consisting not only in much air, great plots of grass, low borders, large gravel-walks, but for close walks, fountains, groves, and statues, to make good the Italian saying, *Per variar natura è bella*. And as for the embossed carved imagery on the frontispiece of a palace, their dimensions must be according unto their distance from the ground; which is a main point requisite to be observed also in schemes, wherein divers undertakers commit very great faults, not only by the not reducing whatsoever is represented, to the true lines of perspective, but also by omitting the giving such proportions to things, as may satisfy the sight of all the spectators at their several distances; for excellence does not consist in vastness, nor in the quantity of objects, nor shapes, nor colours.

The sphere in an angle of a great chamber in S. Pietro à Vaticano in Rome confirms this truth, and every judicious eye will be satisfied therewith. Seas must not only be seen to have a natural motion, but heard to make a noise of breaking of their waves on the shore and against the rocks. Clouds must not only drive, but be transparent. Winds, thunder, lightning, rain, snow, and hail, must be so heard, seen, and felt, as that spectators may think those sights to be natural operations. The sun, moon, and stars, no pasteboard devices; but so represented, as that they may dazzle the eyes of spectators. And all the motions of scenes and mutations as insensible, and no more to be discovered, than that of the hand of a dial.

Neither can all great rooms of princely palaces serve for this use, except they be after the model of such as the Italians have built; as there is a good one at Florence, in Italy, with conveniences for smoke, and capacities for echoes, which Inigo Jones (the late Surveyor) experimentally found at Whitehall, and by his built Banqueting-house; so as having found his own fault, he was constrained to build a wooden house over-thwart the court of Whitehall.

The greatness of a sovereign consists not in the quantity of stone and timber heaped together. The quarries possess more stone, and the woods more timber, than a banquet-room. Let any good eye judge, whether it be not true, that the extreme height of a room takes away the greatness of the company that is in the same, and that all hangings of tapestry make no show at all, unless they reach to a proportionable height of a room.

Since the greatness of a nation consists not in a husk, but in

itself, and in its sovereign, nothing should be suffered to diminish the appearance of that greatness within or without doors. A sovereign and his retinue, in a too vast room in height, width, and length, appear like a company in a valley near high mountains. Whereas, a body standing on the brow of a hill, and seen from below, seems to be a kind of colossus; which argues that there must be a great discretion used, in the making them fit and pleasing.

All which I do not write to undervalue any modern works, nor any of the cavalier-like operas,—every good talent being commendable. As I am confident there are some that live, who will not deny that they have heard the King of blessed memory graciously pleased to avouch he had seen, in anno 1628 (close to the gate of York-house, in a room not above thirty-five feet square), as much as could be represented (as to scenes) in the great Banqueting-room of Whitehall; and that divers judicious persons will not deny, that the excellence of the several triumphal arches erected in the city of London, consists not in their bulk.

The Grecians and Romans (who have shewn their mastership in them) did conform them to the respective places.

Things can be too great, as well as too little; too massive, and too slender; too gaudy, and too plain; and colours placed together, which agree not one with the other, God, in his rainbow, having shewed us the best way of ordering colours. Nor is it the quantity of timber or stone that speaks love, in an arch; but, rather, when it is composed of the hearts of loyal subjects, which surpasses all that can be made.

May, therefore, the oldest and most tottering house in the land, breathe forth of its windows what may answer that true love; and in point of good building, wherewith this discourse is begun (next to the giving such a new form to the streets of London and the suburbs, as may in a manner equalize those in Holland in neatness, if the inhabitants will but take the right and only course therein), may his sacred Majesty, during his long prayed for and wished reign, see St. Paul's church in that magnificence, as the metropolitan of the houses of God in the chief city of Albion, justly requires; and his royal palace built, so as to answer the matchless greatness of him, whom all tongues of loyal subjects speak to be *Carolus Magnus Secundum, Dei gratia, Anglicæ, Scotiæ, Franciæ, et Hiberniæ Regem, ecclesiæ, legum, et libertatis populi restauratorem*; which shall ever be the dutiful wishes of

BALTHAZAR GERBIER D'OUVILLY, Knight.

EXTRACTS FROM THE COUNSEL AND ADVICE TO ALL BUILDERS.

(First) Printed in the Year 1663 (and again in 1664).

From the Preface:—Furthermore, you may gather out of this treatise, a posse pleasing to your scent, and leave the gleanings, which are most proper to mechanics concerned therein, until a large work (with copper plates) shall have had time to be put forth; wherein, not only shall be represented in complete measure, the forms of all moldings, of orders, columns, ornaments for

doors and windows, courts, houses, and garden gates; and withal some fronts and dimensions of houses, both in a city and in the country; churches, towers, houses, and steeples, with all necessary appurtenances thereunto belonging; as also the charges a builder may be at, according to the extent and height of a building, either made of stone, brick, or mixed.

Page 98:—Furthermore, in reference to the main contents of a former printed discourse, concerning the three first principles of magnificent building: as the well choosing of a fit place for a building is a capital point, to set it right, and the giving a fit extent to the court, so the making to it a porch ought to be well considered; for as a porch serves to a hall, to distribute alms to the poor; a porch proves often cumbersome, being the receptacle of foul creatures, who, as soon gotten into a court, make it their rendezvous. Nor is a porch so convenient to the palace of a prince, whose person must be attended by a great retinue, and no man to stand in his passage: but if a porch be affected, let it then be a vast portico, as that of Solomon's house, and that he built for Pharaoh's daughter.

Now, as for the placing a gate or door to enter into the hall of a palace; none will deny but that greatness and conveniency, being conjoined, fits best. The entrance into a hall is not so proper in the middle as at the end, when the ground plot is yet to choose and to be ordered: but if there be a constraint, which is most prejudicial to a building, the entrance must be set as much towards the end as possible can be, to set the chimney well, and the main staircase in so fit a place, as that it may not be subject to a like fatal accident, as happened to William, Prince of Orange, at Delft, when he was shot by one who stood behind a column, opposite to the stairs of that prince's house.

The rise, width, and depth of steps, shall not need to be repeated, since they have been described, and by reasons alledged for their dimension, mentioned both in the former printed and in this discourse; nor shall repetitions be necessary concerning the reason, why the first floor of a building should not lie level with the ground; the first for health; the second for neatness, since any floor level with the ground receives more dirt from abroad; the third for greatness, which appears more by an ascent; the fourth for the vaulting of cellars, or any other offices; and the fifth to have the floors more dry: only I shall insert this story of one in authority, who, passing by a town wherein the people generally did not outlive the thirtieth year of their age, caused all the back of their houses to be made the front, and the windows which were forward to be made up, to free them from that infectious air that did shorten their lives, which had its effects accordingly; and it is therefore I do so much insist on the point of placing a building where good air is, and that neither chimneys nor doors may be so placed as to serve for the attracting of infectious air, which kills more than the sword, or the seas overturn ships.

To take my leave of all builders, I must conclude with what followeth:—

First, that when they shall be pleased to take a posie out of the former printed discourse, and join it to what may please them out of this, they will find that both hit the main mark, to wit, solidity, conveniency, and ornament, altogether to be observed in true building; that all what is represented is for their profit and satisfaction; that the manner and phrase of the first discourse was to that end intermixed with recreative passages; that the reader should not be tired with the mechanics' phrases, and the proper names of their several trades, though some of them are wont to scoff at those whose language is polished, as if a person of eminent quality (born to the highest concernment of a state), should have learned their words, and have spent therein part of his precious time: and therefore I have now offered to write in such workmanlike terms, as may serve for a clerk of the works to speak unto them.

Secondly,—that all owners of buildings shall do well to make choice of such a person for their clerk as the master workmen will endure, which they will not, if he be a master workman, whom they will not only suspect to have a design to undermine and supplant them, but obey not, pretending to know more than themselves. Nor is it fit that there should be such a controller over a master workman, as a workman. The same is to be observed with a Surveyor, to prevent all quarrels and contests; for as every cook commends his own sauce, more than one cook to a dish will spoil it: there cannot be two suns in the firmament, one general over another, nay, two cocks among hens.

In a word, an owner must trust, or never make choice of trustees; for if otherwise, let him be certain that his purse will be incessantly abused.

Thirdly,—let all owners be prepared to repent, whether they build or not, for it is likewise the fate of many that marry or marry not.

Let both one and the other lay as in a scale, their several charges, vexations, cares, labours, and pleasures; they will find this to be true, viz. if they build, they must be at great present disbursements, vexed with as many oversights as printer setters will commit faults (as appears by the errata at the end of books), and to be overreached in bargains concerning their materials, as also in work done by the great or day.

If they build not, they are subject to the inconveniencies of houses built according unto the fancies of the owners, and when they shall cast up the sums of money spent in the rent (besides many chargeable alterations), they shall find that they might have built a better and more fit habitation: so will it be with men that marry or marry not. * * *

Page 108:—Now of these two sorts of men, the one will resolve on the affirmative, and delight to spend money on choice materials, as in particular to imitate Solomon, in the procuring of precious wood; they may take notice (if they please) that store of precious wood can be had for the boarding of princely palaces, both for colour, aromatic smell, and durance; to make square framed panels (more rich than those which are seen at Paris in the cabinets of the palace called d'Orleans), which precious woods are to be had in several parts in the West Indies, some whereof are as red as the fairest vermillion, some yellow as gold, hard as marble; besides rare madeira, and others variously figured, as the right honourable the Lord Willoughby of Parham well knoweth what extent of land about Surinam (at Abacoa), is beset with speckled wood, and is not above six weeks sail from England, where ships full of lading may be had, besides large timber eighty feet high, straight, without a knot; and at no other cost but filling and lading, more advantageous than to pay for fur from Norway; besides a very gainful return of ambergris and vendible commodities, in exchange of iron tools, scissors, knives, old linen, and trifles.

To conclude. May all builders, both of palaces and of particular habitations, have good success, and possess them in peace and prosperity.

May also all Surveyors, master workmen, journeymen, and labourers, behave themselves so as they ought.

Take well this former counsel and advice; give no admittance to pride, the enemy of all learning; whereof a King was such a lover, as that when near the hour of his leaving the world, he saw one advance more than others within the curtain of his bed, he asked, "Whether he could learn him anything that was good?"

DICTIONARY OF ARCHITECTURE.

HABE

H HINGE. A hinge, generally of wrought iron, with a small knuckle and in the shape of the letter **H**. It is chiefly used for ledged doors which are not large enough to require strap hinges, for ledged shutters, small flaps, or other light work, and is often fixed with nails instead of screws. It ranges in sizes from 3 to 8 ins. by differences of an inch. A. A.

H- HINGE. A hinge so called from its resemblance to a combination of the letters **H** and **L**. Like the **H** hinge, it is generally of wrought iron, and is used for work where the latter is not strong enough, and the strap hinge too large and heavy for the purpose. It ranges in sizes from 6 to 12 ins. by differences of an inch. BUTT HINGE. A. A.

HAARLEM (HAERLEM and HARLEM). The capital of the province of the same name in Holland, situated on the river Spaaren, which flows into the Zuyder-Zee. It is one of the best towns in Holland: the streets are straight, remarkably clean, well paved, lighted with gas, and traversed by canals bordered by trees. A bronze statue by Royer to L. Coster, to whom the Dutch attribute the invention of movable types in 1424, was erected 1856 in the market place; a monument to him had been placed 1824 in the Haarlembosch.

The cathedral church, the largest in Holland, dedicated to S. Bavon, was built 1471-1538, chiefly by P. Bagyn; the bell-tower, erected in 1516, is about 230 ft. in height. This noble edifice of the Gothic style is 425 German ft. in length, and contains the gigantic organ built in 1755 (or 1735 to 1738) 36 ft. wide and 98 ft. 5 ins. high; it is considered one of the most powerful and best toned instruments in the world, containing 8,000 (some authors say 5,000) pipes, sixty-eight registers (stops), and four sets of keys. The view by Saerдам, engraved by Jan van de Velde, and the great picture by J. Bosboom, are amongst the best representations of the church. Another, called the New church, was designed in 1647 by S. de Bray. Amongst the other buildings, the *stadhuis* or town-hall, 1630-33; the palace or *prinzenhof*; and the town prison, are the most remarkable. The old abbatoir or *vleeschall*, built 1600, is noticed *s. v.* DUTCH ARCHITECTURE. Near to Haarlem, in the grove called Haarlembosch, is the royal summer palace, formerly called 'Welgeleen' when the property of the banker Henri Hope, for whom it was built at the end of the eighteenth century by J. B. Dubois, from a design by Triqueti; it is three floors in height; the walls are of brick covered with cement; the staircases are of Carrara marble. Water is conveyed from the Haarlem sand dunes to Amsterdam, by a pipe constructed lately by an English company. The drainage of the celebrated lake of Haarlem was undertaken 1848-52. 14. 28. 114. 115.

HAAVE, see **HAVEUS** (THEODORE).

HABENRIES. A term said to be used in CHAUCER, *House of Fame*; DALLAWAY, *Discourses*, 8vo., London, 1833, 172,

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HABE

supposes it to mean "tabernacles": BRITTON, *Dict. s. v.*, states that in some editions the word "barbicans" is substituted, which must be a misprint. In the edition fol., London, 1542, fol. ccxci, a, col. 2, a word like it thus occurs:—

"Both the castell and the toure,
And eke the hall, and euery boure
Without peces or ioynnynges,
But many subtell compassynges,
As babeuries (*sic*) and pynnales,
Ymagines and tabernacles
I sawe, and full eke of wyndowes
As flakes fallen in great snowes,
And eke in echo of the pynacles
Werē sondrye habytacles
In which stoden all withouten
Full the castell all abouten"—

The Glossary to SPEIGHT defines 'babeuries' as 'antiquets'. The word is probably derived from *baubella*, a low Latin term (DU CANGE) for ornamented work like jewellery, from whence comes the word 'bauble', and the Fr. *babiole*. A. A.

HABERSANG (JOHANN PAUL) was born at Leipzig in 1732. He executed many designs; and was teacher of architecture at the academy of his native town. He died about 1796. 68.

HABERSHON (MATTHEW), of a Yorkshire family, was born in 1789, and exhibiting much talent for drawing entered the office of William Atkinson in 1806, to whom he was articled for six years, and with whom he remained some years as assistant. He exhibited many designs between 1807 and 1813; with 1816 "house in the castellated style near Bolsover, Derbyshire"; 1819 design to celebrate the "military victories of the late war"; 1824 "new church at Belper, Derbyshire, now building"; in which county he also erected the churches at Minster, and at Bishop Ryders; that at Kimberworth, Yorkshire, etc. At Derby he erected the town-hall, since destroyed by fire; the county courts; and the market; also many schools, rectories, and private houses at other places; among the latter, 1827 Hadsor house, near Droitwich, Worcestershire, for J. Howard Galton, esq.; Aylmore Grove cottage, Stanmore, Middlesex, for J. Marks, esq.; and Seacroft, Yorkshire, for J. Wilson, esq.

He also designed many large works for the London Society for Promoting Christianity among the Jews, for whom in 1842 he visited Jerusalem to arrange for the erection of the Anglican cathedral, taking with him the drawings and a resident clerk of the works; this church with the buildings connected with the mission were carried out from his designs. While returning from the Holy Land in 1843, he had an interview of some length with the late king of Prussia, who was associated with England in the establishment of the bishopric: and the king in 1844 conferred on him the great gold medal for science and literature, in token of his approbation of the publication by Mr.

Habershon, *The Finest existing Specimens of Ancient Half-Timbered Houses of England*, fol., London, 1836, which was soon out of print. The work by JOHNS, *Illustrations of the Anglican Catholic Church of S. James, Mount Zion, Jerusalem*, fol., London, 1844, describes the above named building. He died in London 1852, and was buried in Abney Park cemetery. Besides leaving William Gillbee, and Edward, both in practice (1864), he had two other sons, and four daughters. Amongst his pupils, besides his eldest son, were Messrs. Ewan Christian; — Critchholm; C. Yoget, now at the Cape of Good Hope; and some others.

W. G. H.

HABITACLE (Lat. *habilaculum*). A small dwelling or den, as in AULUS GELLIUS, v, 14, where it is applied to that of a lion. The word is used by CHAUCER, as in the quotation given s. v. HABENRIES, to signify the niche under a pinnacle. A. A.

HACK and HACK HOUSE, see BRICK, MANUFACTURE OF, p. 139 and 140.

HACK BOARD to plaster cornices, at per foot, 3*d.*, is an item in a *Price Book* for 1787.

HACKER (HEINRICH), *baumeister* at Ulm, in 1690 repaired the Oelberg; and in 1696 built the church at Altheim; over the entrance to which building is placed his monogram "H. H." From his designs, as well as from his well written reports, it may be inferred that he had received a very good education. He died in 1716. WEYERMANN, *Nachrichten*, 8vo., Ulm, 1829, p. 148.

68.

HACKET, or AQUETE (DAVID), see OUGUET.

HACKING. A term used in Scotland, particularly in Glasgow, for the interruption of a course of stone in a wall by introducing another course upon a different level, in consequence of the want of stones to complete the whole thickness; and thus frequently making two courses at one end of a wall or pier, of the same height with one course at the other end. The last stone laid in one height is frequently notched to receive the first stone of the other, where the two heights commence. Hacking is never employed in good work, and ought always to be guarded against in contract work; NICHOLSON, *Dict.* s. v. The practice is of frequent use in medieval masonry, and assimilated to the third period of ancient Cyclopean masonry. In Kent, among the ragstone masons, it is called 'random coursed work'.

HACKMATACK. The timber of the LARIX AMERICANA.

HADFIELD (GEORGE) in 1784 received the first gold medal for the travelling studentship in architecture at the Royal Academy of Arts in London, at the exhibitions of which he sent designs in that and the three previous years. He made with Signor Colonna in 1791 drawings from their measurements for a restoration of the temple at Palestrina near Rome, which are now in the collection of the Royal Institute of British Architects; and exhibited in 1795 drawings from his measurements of the temples of Mars, and of Jupiter Tonans.

"The design for the Capitol at Washington (cir. 1800) was made by Dr. William Thornton, who received the premium for the same. The north wing was chiefly built by Mr. George Hadfield, who was selected by Colonel Trumbull in London, under the authority of the commissioners for laying out the city, to superintend the building of the Capitol; but unfortunately a dispute arose between him and them, which ended in his leaving the public employment. He gave the designs of the public offices, the city hall, Custis's mansion, Commodore Porter's, Gadsby's hotel (when Weightman's buildings), Fuller's hotel, the United States bank, Van Ness's mausoleum, etc. He died 1826"; DUNLAP, *Hist. of the Arts*, etc., 8vo., New York, 1834, i, 336. W. Hadfield, an artist of Clarges-street in 1784, appears to have been a relative.

HADHR (AL). The modern name of HATHA in Syria.

HADIWICKE. A moderately hard, fine, close grained, and rather heavy wood of Ceylon.

71.

HADRIA, in Italy, see ADRIA.

HADRIANEIUM (Gr. Ἀδριανέιον). A name applied to

buildings of the second century, about which there has been some controversy. The principal notices are from EPIPHANIUS, *Hæres*, xxx, 12, who speaks of a large building so called at Tiberias, which continued unfinished until, after being devoted to the purpose of a bath-house, it was partly completed for the accommodation of a small congregation of Christians, by a converted Jew named Ἰώσηπος (BINGHAM, *Origines*, 8vo., London, 1840, ii, 395, calls him Josephus Comes); and lxix, 2, he says that at Alexandria there were several churches, besides that lately built and named the Cæsareia, including the structure called formerly the Hadrianeum, but afterwards the Licinian gymnasium or basilica, until its conversion into a church in the time of Constantine. In the life of Alexander Severus by ÆLIUS LAMPRIDIUS, it is stated that Hadrian had ordered temples without images to be made in all cities, and that (because they had no deities) in the author's time these were called 'Hadriani'. Some critics think that these buildings were intended by him to be used for the worship of himself after his death; others suppose that he intended them for the use of Christian worship, and there are many late legends to that effect without contemporary authority. As these buildings appear to have had no architectural peculiarities, and to have differed from other temples only inasmuch as they had no images (*sine simulachris*), any examination of the controversy would be out of place in these pages. It may be found in CASABON, *Notes on LAMPRIDIUS in loco*: PAGIUS, in the *Commentary on the Annals of BARONIUS*, an. 124; and HUETIUS, *Dem. Evang. Prep.*, iii, sec. 22.

A. A.

On comparing the statements of LAMPRIDIUS and EPIPHANIUS, it would seem that they allude to some of the structures commenced under Hadrian as temples in his own honour, which if not consecrated before his death, were allowed to remain unfinished, or to be converted to other purposes: but being called a Hadrianeum when it was commenced, such an edifice would naturally retain the name until another was bestowed upon it. It is remarkable that neither in OPTATUS, *Opera*, 8vo., Paris, 1842, i, 1, nor in CIAMPINI, *De Sacris Edificiis*, fol., Rome, 1693 (not 1683), i, 7, as cited by BATISTIER, *Histoire*, 8vo., Paris, 1845, p. 358, does the authority appear for his statement that the emperor Hadrian, after having read the *Apology* by S. Quadratus, permitted the Christians to assemble in small edifices called 'Adrianeia'.

HADRIANI (Gr. Ἀδριάνοι). A city in Bithynia, now represented by a village called Adranos or Edrenos, which is noticed by HAMILTON, *Researches*, 8vo., London, 1842, i, 90, on account of the three arches of an ancient gateway; of the remains of the sculpture of two buildings of a Doric and Ionic order; and of the southwest wall, built of marble without mortar, about 3 ft. thick and 30 ft. high, belonging to an edifice which he supposes was a gymnasium about 88 paces long and 65 paces wide.

HADRIANOPOLIS, in Roumelia, see ADRIANOPLE.

HADRIANUS (PUBLIUS ÆLIUS), emperor of Rome 117-138, has for some time been included in the list of amateurs who have practised architecture; but, as is the case with many rulers, ecclesiastics, and other great or wealthy patrons of the art, there seems little foundation, if any, for supposing that he designed. The idea was probably founded on the strength of the account given by DIO. CASSIUS, *Hist. Rom.*, fol., Hamb., 1752, lxix, 4, of his conduct, under the adverse criticism of the architect Apollodorus upon the design for the temple of Venus. It appears that the latter was in consultation with the emperor Trajan as to some buildings, when Hadrian, who was present, made exceptions to the design. Apollodorus answered that Hadrian knew nothing about architecture. This reply seems to have rankled in his mind, so that when he succeeded Trajan as emperor he banished Apollodorus. Some time after, when the temple of Venus and Rome was erected, Hadrian sent a drawing of it (διδάγραμμα) to Apollodorus in exile, saying that he might now see that the emperor could do without him, and

haughtily demanding an opinion of the design. Apollodorus answered coolly, shewing several defects in it, which exasperated the emperor so much that he ordered him to be put to death. This conduct has led many persons to think that Hadrian might personally have had some hand in the design. There is, however, no proof that it might not have been by Detrianus, and that it was the fury of the tyrant rather than the wounded pride of the amateur which prompted this punishment. From CASSIODORUS, *Chronicon*, fol., Rouen, 1679, ii, 388, sub anno u.c. 888 (A.D. 135), this must have occurred shortly before the emperor's death. Hadrian's conduct to Apollodorus, and his want of taste, may be judged by the assertion of DIO. CASSIUS that Hadrian preferred Antimachus as a poet to Homer; this is also noticed by FÉLIBIEN, *Recueil*, 4to., Paris, 1696, pp. 103-12.

A. A.

As emperor, he destroyed the theatre of Trajan in the Campus Martius; and during his travels directed that the following works should be executed: viz. eighty miles of the celebrated wall in England; the basilica named after his wife Plotina at Nîmes; the restoration of the temple to Augustus at Tarracena; Hadrianopolis in Illyricum; the harbour at Lupiæ; a bridge at Eleusis; a temple covering the ancient oaken shrine of the equestrian Neptune outside Mantinea; the small temple joined to the older one to Apollo at Abæ; a portico at Hyampolis; the restoration (rather than completion) of the temple to Jupiter Olympius at Athens; the stoa, arch, aqueduct, and new town (Adrianopolis), as well as the shrine called the Pantheon, a gymnasium, and a temple to Juno and Jupiter called the Panhellenicum (but DIO CASSIUS states that this building was dedicated to Hadrian), with a library celebrated by CASSIODORUS, in that city; the restoration of Antinoë, afterwards Adrianopolis, in Thrace; Hadriani, and Hadrianopolis, in Bithynia; Hadrianuthère in Mysia; Hadrianopolis in Phrygia; and Antinoë or Antinöpolis in Egypt. He caused the erection of one or more structures in almost every city under his dominion, especially in the Asiatic provinces, of temples to his own honour, some of which he seems to have personally consecrated, but many appear to have been stopped in their progress at his death: HADRIANÆUM. At Corinth he provided the funds for the new thermæ. At Rome he restored the Pantheon, the Septa (? Julia), and the basilica of Neptune, with other sacred edifices, as well as the forum of Augustus and the thermæ of Agrippa, consecrating them all in their ancient names; and constructed the temple to the Bona Dea, the pons Ælius, and the sepulchre near the Tiber, which was finished by Antoninus Pius, and does not appear with certainty to have ever received the remains of Hadrian, as the Senate, hating him, fixed upon a temple at Putæoli for his tomb, although they afterwards joined his successor in dedicating to him a temple at Rome: SPARTAN, in vit. *Hist. Aug.*, 8vo., Leyden, 1661. The sepulchre (now the castello di S. Angelo) is described by BURGESS, *Transactions of the Royal Institute of British Architects*, 1849-50; and given in the *CIVIL ENGINEER Journal*, xiii, 153. Hadrian's celebrated villa at Tibur is described by SPARTAN, 26, and the remains are illustrated in LIGORIO and CORTINI, *Pianta*, fol., Rome, 1751. These works have been supposed by authors of good repute to have been actually designed by Hadrian. But with regard to the temple to Jupiter Olympius at Athens, PAUSANIAS, i, 18, says that he dedicated it (ἀνέθηκε), and no proof exists that he was any more than a liberal building patron; although no notice occurs of any architect employed by him, except DETRIANUS to remove the colossal statue dedicated to the Sun; and except APOLLODORUS to make a corresponding one consecrated to the Moon.

From his affectionate respect for the memory of his father by adoption, Trajan, he completed the buildings commenced during his reign, and struck various medals commemorative of them, as illustrated by DONALDSON, *Architectura Numismatica*, 8vo., London, 1859.

HADRUMETUM. The ancient name of Susa in Tunis.

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HÆMATOXYLON CAMPECHIANUM. Campeachy logwood, is procured from the bay of that name, and from Jamaica, Honduras, etc.; it is very largely used as a dark purple-red dye-wood.

HAERLEM, in Holland, see HAARLEM.

HAERLEMANN (CARL FREIHERR VON), born in 1700, was superintendent of the royal buildings at Stockholm, where he almost completed the new royal palace designed by N. Tessin. He was a knight of the Polar Star; and died in 1753, in the fifty-third year of his age. TESSIN, *Gedächtnissrede auf C. H., aus Schwedischen übersetzt von J. C. Daehnert*, 4to., Griefsw., 1753, has not been seen. 68.

HAERLEM BLUE. This colour is better known as *Antwerp blue*, and is a light Prussian blue.

HAFFENECKER (ANTON), imperial court architect, was born at Prague about 1725. He finished between 1769 and 1775 the palace at that city, which had been commenced by R. Lurago and continued by A. Gunz. 20.

HAFNIA. The late Latin name of COPENHAGEN, in Denmark.

HAGENAUER (WOLFGANG), a brother of Johann the celebrated sculptor, was born in 1726 at Strassburg. He assisted his brother in finishing his statue of Mary, and in embellishing the new gate (most probably of the town). He died at Salzburg in 1801, aged seventy-five, being then *bauverwalter*, steward or director, of the Board of Commissioners for Buildings. He left seven river maps, published by Koch, *Wasser und Strassenbau*, etc. 26. 68.

HAGIASMA (Gr. Ἁγίασμα). This word was used by EUSEBIUS, *Hist. Eccles.*, vii, 15, for the communion-table, but it means the bema according to DUCANGE, *Gloss.*, fol., Lyons, 1688, who notices that it was more usually employed for the basilica.

HAGIASTERIUM (Gr. Ἁγιαστήριον). The baptisterium (probably the font) according to DUCANGE, *Glossarium*, fol., Lyons, 1688.

HAGIOSCOPE (Gr. ἅγιος, holy, σκοπεῖν, to view). A term introduced by the CAMBRIDGE CAMDEN SOCIETY, *English Ecclesiology*, 12mo., London, 1847, p. 200 (which gives a list of ten examples), to replace the words *loricula*, *elevation aperture*, and *squint*, designating the small openings, which were cut through one or both sides of a chancel arch, or through a chancel wall, obliquely into an aisle or chantry; their purpose was evidently to enable the worshippers to obtain a view of the elevation of the Host, as may be judged from the plan and description of the oratories of the princess in the church at Brou, given in DIDRON and DUPASQUIER, *Monographie*, fol., Lyon, 1842, p. 35: and in some cases they are evidently additions, as at Alderton in Wiltshire, *BUILDER Journal*, 1845, iii, 223. Amongst the most remarkable instances in England may be cited the three cut in one line through as many successive walls at Bridgewater; and the large double ones at Hadley in Middlesex, and at Otterbourne in Hampshire. Of the hagiocopes commanding a view of the altar from the southern sacristies in the church of S. Redentore at Venice, WEBB, *Sketches*, 8vo., London, 1848, p. 289, says "sometimes a monk may be seen attending to the service through these: at other times they are used for the sacristan to observe what is going on, that he may give signals to the bell-ringers in the adjacent tower." The same writer has given, pp. 179, 191, several notes of the common occurrence, between Innsbruck and Como, of low windows in the western wall of the churches and chapels; to these he applies the name of hagiocope, a term that has even been applied to the doorways of churches when the door is replaced by a grille, and to the grated opening, which replaces the western doorway, as in the church of Sta. Maria Coronata at Puratelli near Bologna. Why a term coined from the Classic Greek should be used to designate an object purely mediæval, is difficult to explain.

HAGUE, THE (Dutch, *S'Gravenhage*; It. *Aja*: Fr. *La Haye*; Ger. *Haag*). The capital of Holland, though but a

village, situate about four miles from the sea-shore at Scheveningen. Although it is the seat of government, the buildings are not of sufficient importance to merit further remarks beyond the general notice *s. v.* DUTCH ARCHITECTURE.

HA-HA FENCE. In landscape gardening, a sunk fence is used with great advantage to extend the apparent boundary of a small property, whilst at the same time preventing cattle from coming into the preserved grounds. "The capital stroke, the leading step to all that has followed [in that art], was (I believe the first thought was Bridgman's) the destruction of walls for boundaries, and the invention of fossées—an attempt then deemed so astounding, that the common people called them Ha! Ha's! to express their surprise at finding a sudden and unperceived check to their walk"; WALPOLE, *Anec.*, Wornum's edit., 8vo., London, 1862, 800; (1st edit. 1771.) It had been used at Sion house, Brentford, before 1761. The ditch is often of a V section more or less elongated at the bottom, in which part is placed the fence, sometimes vertically, and sometimes at an angle.

HAHN (CONRAD), in the service of Peter the Great of Russia, erected many buildings at S. Petersburg, one of which is the Newsky convent. The circumstances of his life are unknown. His sons ADAM and CONRAD were architects at Schweinfurt about 1789. 68.

HAILES QUARRY. A large freestone quarry, situated about three miles west from Edinburgh, near the village of Slateford, in a level country. The rock is found at a considerable depth below the surface. As the stone has been in extensive demand for many years, the quarry presents large perpendicular faces which are easily worked, the layers in general not exceeding three feet in thickness with thin beds of dark clay between. The stone is of a grey colour, easily split into any required thickness, and very large superficial areas; it is commonly laid or built on its natural bed, and is used for common rubble walling; in coursed work more or less dressed for outside walls; in dressings for fireplaces, in stairs, platys, and pavements. Some experiments recorded by BUCHANAN at the Royal Scottish Society of Arts, 10 April 1848, and given in the *CIVIL ENGINEER Journal*, xi, 153, show that this stone bore 360 lbs. on the square inch.

HAINAUT (JEAN DU) was in 1322 *baumeister* at Utrecht cathedral. 92.

HAINHOFER (. . .) designed the *kunstschrank* or art cabinet in the Chamber of Arts at Berlin, made 1610, and executed chiefly by the well known Ulrich Baumgartner, and on which worked twenty-five artists whose names are all recorded; *BUILDER Journal*, xv, 33.

HAIR. A material much used by plasterers in the first coats; indeed it formerly was used even in the fine stuff or setting coat. It is obtained from the tanners' or curriers' yards, but it should never be used if it has been in the tan-pits, as the process employed renders it rotten and consequently unfit for plasterers' work. The hides, usually of horses or oxen, are first immersed in quick lime, which loosens the hair on them so that it is easily scraped off. It is then sorted into three classes, according to the quality of its 'staple', and numbered 1, 2, 3, the latter being the best. In the North it is usually sold by the bushel; in London and the South by weight. A bushel of dry hair will weigh 14 to 15 lbs., and will be sufficient for from 70 to 80 yards superficial of coarse stuff. Its prime cost now is from 10s. to 12s. the cwt. Before being mixed with the lime and sand, the hair is thoroughly beaten with pieces of lath to get rid of dirt, and to disentangle it as much as possible: it is then stirred into the mass when in a fluid state by a sort of rake. The presence or absence of hair makes the difference between mortar and plaster. The object of its use is to bind, or, as it were, tie the particles together, so as to prevent the material cracking when drying. For this reason it is also used for "lime and hair filleting" against brickwork, for pointing pan-tiling, and other similar purposes.

Coarsely chopped hay and straw has been used for a very long time as a substitute for hair in plastering in very inferior work. In fact any material of short fibre would in some degree answer the purpose. Hair, however, does not shrink in length, and is very little affected by moisture, as are those other materials, and is therefore the better in all respects. Cow-dung is also used to bind lime together, as it contains short particles of fibrous matter; this will resist heat to a very great degree, and is therefore used for the inside of chimneys; it is usually called **PARGETTING**.

A. A.

In the preparation of the material that is generally employed for the rendering coats of plasterers' work, it is customary in London to allow three bushels of hair to the yard cube of chalk lime, unslacked.

G. R. B.

Two parts of lime being mixed with three of sand, one pound of hair is put into two cube feet of this mortar. The old practice for 'white mortar' or the setting coat, was to allow one bushel of hair to six bushels of lime. 4.

HAIR BROWN. A colour formed of brown with a little yellow and grey; its representative is wood opal and brown iron ore (hydrous oxide); ANSTED, *Elementary Course*, 8vo., London, 1850.

HAKETUS was the fifth Cistercian abbot 1179-1185 of the monastery of Notre Dame des Dunes near Bruges, said to have been built by its own monks; SANDERUS, *Flandria Illustrata*, fol., Hague, 1641-4, i, 248.

HAKEWILL (HENRY), F.G.S., born 4 October 1771, was the eldest of the eight children of John Hakewill (1740—Sept. 21, 1791, EDWARDS, *Anecdotes*, 4to., London, 1808, 183), landscape and portrait painter, painter and decorator, whose works in arabesque and chiar-oscuro decorations exist at Blenheim (ceiling of bow window room, etc.), Chisbury, Marlborough house, and Northumberland house; he obtained the silver palette medal of the Society of Arts, etc., for a landscape in 1771. Henry was articled to John Yenn, R.A.; and he obtained permission, on the death of his father, to absent himself, two years of his term being unexpired, for the purpose of keeping together the business and settling in it his younger brother James; having arranged this matter satisfactorily, he returned to Mr. Yenn's office. In 1790 he obtained the silver medal of the Royal Academy for a measured drawing of the Strand front of Somerset House; and exhibited at that institution from 1792 many of the following designs.

His first works were for Mr. Harenc at Footscray in Kent; with various improvements for Lord Bexley after his purchase of the same property. In 1801 he designed Rendlesham house, Suffolk, for P. J. Thellusson, esq.; 1804, Cave castle near Hull, Yorkshire; works at Albury Park in Surrey, for Hy. Drummond, esq. (NEALE, *Seats*, etc., 4to., London, 1826, 2nd ser., iii); at Packington in Warwickshire, for Lord Aylesford; at Holm Park in Berkshire, for Robert Palmer, esq.; at Cornbury Park, Oxfordshire, for Lord Churchill; at Leamington, for Matthew Wise, esq.; at Stone castle, Kent; at Dingley Park, for H. H. Hungerford, esq.; at Stisted hall in Essex, for Charles Savile Only, esq.; at Blenheim, for the duke of Marlborough, where he built the aviary (NEALE, iii, 1st ser., 1820); and at many other country seats of the nobility and gentry.

In 1809 he was appointed architect to the trustees of the schools at Rugby, of which he designed the buildings, chapel, and residences in the Gothic style, retaining the appointment until his death; he was also architect to the Radcliffe trustees at Oxford, where he made alterations to the observatory and infirmary; and to the benchers of the Middle Temple, London, where he fitted up the library in 1822-4, designed the louvre in the roof of their hall, restored the screen with the northern entrance or porch, and designed Middle Temple chambers; these being executed 1831 under the direction of James Savage. He also designed the judge's house at Warwick. Amongst the churches erected under him in the Gothic style, is that at Wolverton; as was the first design for the church of S. Peter,

Eaton-square, London, which was rejected by the committee for one by him in the Grecian style, the first stone was laid 4 September 1824, and consecrated 20 July 1827; having been destroyed by fire in 1836, it was rebuilt under the superintendence of his son in the following year, from the original drawings. He wrote *An Account of the Roman Villa discovered at Northleigh, Oxfordshire, in the years 1813-4-5-6*, on its discovery; this was printed in SKELTON'S *Antiq.*, 4to., Oxford, 1823, and was reissued in 1826 by Mr. Hakewill, with five additional plates.

He died 13 March 1830, in the sixtieth year of his age, and was buried at North Cray in Kent. His two sons, John Henry, and Edward Charles, are (1864) in practice. Amongst his other pupils were John Turner; John Winkworth; and John Goldiecutt, who after his tour returned to Mr. Hakewill's office until the death of the latter, and was associated with him in the competition for the Hanwell lunatic asylum, in which they obtained the third premium. J. H.

HAKEWILL (JAMES), born 25 November 1778, was the second son of the John Hakewill named above. Preferring the pursuits of an artist to continuing his father's business, he exhibited at the Royal Academy of Arts, in 1800, an ornamental panelling for an eating room; 1806, a design for finishing a library; and 1813, a triumphal column to commemorate the defeat of the French in their attack upon Russia in 1812. In this year he published *The History of Windsor and its Neighbourhood*, imp. 4to., with 21 plates and 14 vignettes from his own drawings. In 1816-7 he visited the continent, and published 1818-20 *A Picturesque Tour in Italy*, 4to., 63 plates, some after drawings by J. M. W. Turner, R.A. In 1820-1 he visited Jamaica, and in 1825 issued *A Picturesque Tour in the Island of Jamaica*, fol. In 1828 he published *Plans, etc., of the Abattoirs at Paris, with consideration of their adoption in London*, 4to.; in 1833, *An Attempt to determine the exact character of Elizabethan Architecture*, 8vo., with plans, etc., of Dorton house, Buckinghamshire, and a parallel with other existing buildings. In 1840 he was engaged on drawings for a work on the Rhine, intended to have been a counterpart to the *Italy*, but it remained unpublished. He is also said to have written a novel, *Colebs Suited, or the Stanley Letters*, small 8vo., 1812.

Amongst his architectural designs were the pump room, chalybeate, Dorton, Bucks, for C. S. Ricketts, esq.; an eating room, and new lodge, at High Legh, for G. C. Legh, esq.; and lodges at Tatton Park, Cheshire, for W. Egerton, esq. In 1836 he submitted a design for rebuilding the Houses of Parliament. He died 28 May 1843, in the sixty-fifth year of his age, and was buried in Paddington churchyard. His wife was a portrait painter of much talent. He had four sons, Arthur William, the subject of the following memoir; Frederick, a portrait painter; Henry John, a sculptor (who died 13 March 1833, aged twenty-one years); and Richard Wentworth. J. H.

HAKEWILL (ARTHUR WILLIAM), eldest son of the above named James, was in 1826 a pupil of Decimus Burton, and studied under Caristie in Paris. He became a member of the Architectural Society, where he read several papers 1841-3, printed in the *CIVIL ENGINEER Journal*, iv, 41; vi, 185: he also gave lectures on Barry's paintings at the Society of Arts. Amongst his few professional works of importance were some buildings for — Ames, esq., at Lyme Regis, Dorsetshire. He published *An Apology for the Architectural Monstrosities of London*, pamp., 8vo., 1835, in reply to one by JUVARA; and *Thoughts upon the Style of Architecture to be adopted in rebuilding the Houses of Parliament*, pamp., 8vo., 1835 (to which a reply was given in one by A. W. PUGIN); *Architecture of the Seventeenth Century, from the Period of Inigo Jones to that of Wren*, 3 parts, 18 plates, fol., London, 1851-2-6; *Plan and External Details, etc., of Thorpe Hall, near Peterborough*, fol., 1852; and *Modern Tombs, gleaned from the Public Cemeteries of London*, 30 pl., roy. 8vo., 1851. He died 19 June 1856. J. H.

ARCH. PUB. SOC.

HALBUTTER (ULRICH) built in 1484 the bold vaulting of the Matthiaskirche at Leisnig in Saxony. The foundation of the church, however, dates in the twelfth century. 68. 92.

HALBERSTADT. A town in Saxony in Prussia, the capital of the circle and of a principality which was lost in 1807. It is a very ancient place, situated on the right bank of the river Holzemme, the see of a bishopric, and is surrounded by walls having seven gates: the suburb is called Gröperstadt. Many of the houses are timber framed and curiously ornamented; in the *Chronologie*, named below, pt. i, pl. 23 and 24, are views of these buildings dating 1500; in the *ALLGEMEINE BAUZEITUNG*, 1845, 1st ser., pl. DCXCI-III, with the dates of 1487, 1539, 1574-9, and 1669; and in VERDIER and CATTOIS, *Arch. Civile, etc.*, 4to., Paris, 1857, ii, 128-221, with the date of 1542.

The principal buildings are, the *dom* or cathedral, dedicated to S. Stephan, erected on a height approached by flights of steps, and is chiefly in the Pointed style, with numerous monuments, and a fine organ. The third building on its site was begun 1060, and consecrated 13 June 1071, was burnt 1179, rebuilt 1195, enlarged 1201-9, further rebuilt 1235, and again consecrated 28 August 1491; the chapter house dates 1514, and its completion 1574: from its size, unity of style, and harmony of arrangements, it belongs to the most important buildings of Gothic architecture in Northern Germany. The interior dimensions are, nave 85 Rhenish ft. high, with aisles about 65 ft. wide, 145 ft. long; the transepts 28 ft. wide, 110 ft. long; the choir (42 ft. high) and aisles 62 ft. wide, 105 ft. long, terminating with a small chapel beyond. The bishop's throne, with its rich Pointed ornaments, carved work, and rood loft; the monuments of provost Jean Semika 1245, and its iron railing 1401; and of margrave Frederick of Brandenburg 1558; the red marble font 1195; the wall paintings; the stained glass windows; the stalls in the choir; the tapestries 1205 from Constantinople and Italy; as well as an altar piece by John Raphon of Eimbeck, all deserve notice. LUCANUS, *Der Dom H.*, fol., 1837; FABER and ROMBERG, *Conversations Lexicon*, 8vo., Leipzig, 1853-57, vi, 317, give a detailed history and description. KALLENBACH, *Chronologie der Deutsch mittelalterlichen Baukunst*, fol., München, 1846, gives, pt. i, pl. 8, 1200-15, the front view of the portal, or substructure of the tower; pl. 12, 1212-27, parts of the cloister; pt. ii, pl. 6, 1245-50, the early Gothic part of the northern transept; pl. 9, 1320, a ground plan and section, with one of the pillars and vaulting enlarged. KALLENBACH, *Geschichts-Abriß der Deutsch mittelalterlichen Baukunst*, 8vo., München, 1846, gives many comparisons between the architecture of this building and other cathedrals; the same plates are given by him in *Die Baukunst*, etc., 8vo., and *Atlas zur Geschichte der D. M. Baukunst*, fol., München, 1847. KING, *Study Book*, etc., 4to., London, 1849, ii, pl. 54-5, gives a plan showing the cloisters, with view and details.

Among the churches is the collegiate church of *Unsere Liebe Frau*, or of Our Lady, an edifice in the Romanesque style, founded 1005, completed about 1147, and restored in 1850; it has a series of ancient bas-reliefs, bronze monuments, brasses, and some wall paintings, which are very curious. It consists of a vestibule under the towers, a nave and aisles, transepts, and three deep apsidal ends, and is about 32 Rhenish ft. wide and 110 ft. long inside. KALLENBACH, *Chronologie*, pt. ii, pl. 1, gives a ground plan and an elevation of the upper part of the towers, with the date 1040-50. Amongst the other buildings of the usual class worthy of notice, are the *rathhaus*, in the Gothic style of various dates; the *raths-keller*, 1440; the *schuhhof*, 1580; and the old *bischofshof* or episcopal palace, now turned to other purposes. 28. 50.

HALEB-ES-SHABHA, in Northern Syria, see ALEPPO.

HALF PACE or HALF SPACE (Fr. *palier, repos*). That part of a staircase which forms a landing, A, between two flights that return. If the upper flight turns (without returning) at

the newel, the landing, B, can only be a quarter pace or quarter space (Fr. *demi-palier*). And if a quarter pace be half filled with winders, which is a practice that is extremely dangerous, and only excusable at the lowest step of a staircase, the landing, C, becomes a half-quarter pace, or half-quarter space (Fr. *double-marche*). FOOT PACE.



HALFPENNY (JOSEPH), of York, drew and engraved the 105 plates for his *Gothic Ornaments in the Cathedral Church of York*, 4to., York, 1795 (London, 1806, and York, 1831); and the 34 plates for his *Fragmenta Vetusta, or Remains of Ancient Buildings in York*, 4to., York, 1807.

HALFPENNY (WILLIAM), "architect and carpenter", published *Magnum in Parvo, or the Marrow of Architecture*, 4to., 1722; 1728; containing designs for archways: *Art of Sound Building demonstrated in Geometrical Problems*, fol., London; 1725, containing a view of a church for Leeds in Yorkshire; *Practical Architecture, or Sure Guide to the Rules of Science*, 12mo., London, 1730; 5th edit. in 1736; 1748; 1751; *Geometry, Theoretical and Practical*, 8vo., n. d.; *Perspective made Easy*, 8vo., 1731; *Twelve Designs for Farm Houses*, 2nd edit., 1749; *New and Complete System of Arch-Designs for Convenient, etc., Houses*, 4to., 1749 (this describes eleven of his publications); *The Country Gentleman's Pocket Companion, for Rural Arch.*, 8vo., n. d.; *Useful Architecture for erecting Parsonage Houses, Farms, Inns, Bridges, etc.*, 8vo., London, 1751, 1760; *Rural Architecture in the Gothic Taste*, 8vo., n. d.; *Rural Architecture in the Chinese Taste*, 61 pl., 8vo., 1752; *Twenty-six New Designs of Geometrical Paling or Chinese Lattice; and for Pavements*, in one folio plate; *Chinese and Gothic Architecture properly Ornamented, being twenty new Plans*, 12 pl., 4to., n. d.; and *Modern Builder's Assistant, or a Concise Epitome of the whole System of Arch.*, 85 pl., fol., 1742, and 1757; these two last works are named in a catalogue as by "W. and J. Halfpenny". LANGLEY, *Ancient Masonry*, fol., London, 1736, p. 147, mentions "William Halfpenny alias Hoare, lately of Richmond, Surrey, carpenter."

J. HALFPENNY is said to have built 1744, Cooper's hall (Roman Corinthian), King-street, now a dissenting chapel; and 1789-94, S. Paul's church, Portland-square, both at Bristol.

HALF ROUND. The name given by workmen to any molding having a semicircular section, as a bead or torus.

HALF SOVEREIGN. The name given by paviors to a 6-in. Purbeck stone pitcher: and also to granite pitching because it is worth half a sovereign a yard.

HALF-TIMBERED BUILDING. This term seems properly to be applied to that kind of construction which was very generally employed early in the reign of the Tudor family, continued till within the last century, and still occasionally used in country parts. In these buildings the lower story is of brick or stone, and the upper ones of timber. But in some of the books on the subject examples are included the fabric of which is *wholly* of timber, no part being of brick or stone except the foundations on which the lower plates are bedded, and the chimneys. There is a third variety of these buildings, where the stonework reaches to the under side or cill of the ground floor windows, as Inch hall; Bramall hall; and Salmsbury; so that strictly speaking, if the former are to be called *half-timbered*, these last should be designated as *quarter-timbered*. In arrangement of plan and general construction, in overhanging upper stories, projecting windows, gables, barge boards, etc., half-timbered buildings do not differ from TIMBER HOUSES. *Illustrations*, s. v., pt. i, 1859; pts. i and ii, 1861; also HABERSHON, *Finest Existing Specimens*, etc., fol., London, 1836; CLAYTON, *A Collection of the Ancient Timbered Edifices, etc., in Hereford, Salop, and Chester*, fol., London, 1846; PUGIN, *Details of Ancient Timbered*

Houses of 15th and 16th Cents. in France, 4to., London, 1836; RIMMER, *Ancient Halls of Lancashire*, 4to., London, 1852; and detached examples in BRITTON, *Antiquities*, etc.; NASH, *Mansions*, etc.; RICHARDSON, *Old English Mansions*, etc.; HALL and HARDING, *Baronial Halls*, etc.; the *BUILDER Journal*; and others.

A. A.

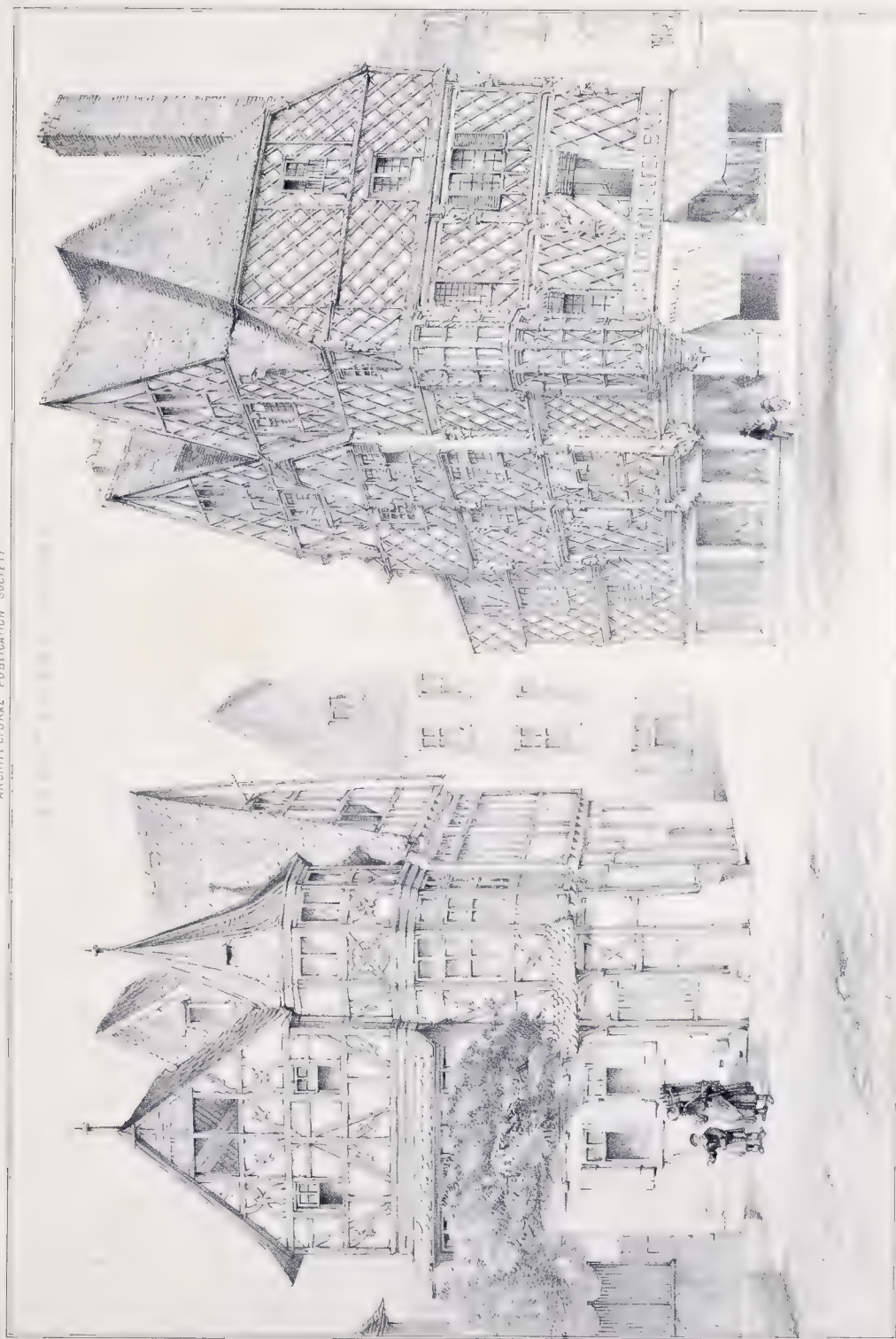
The little church of Newland, and the nave of Besford, both in Worcestershire; the church at Mattingley in Hampshire; the chancel of Crowfield chapel at Coddensham near Ipswich (*BUILDER Journal*, xx, 483); are examples of this mode of construction in ecclesiastical buildings.

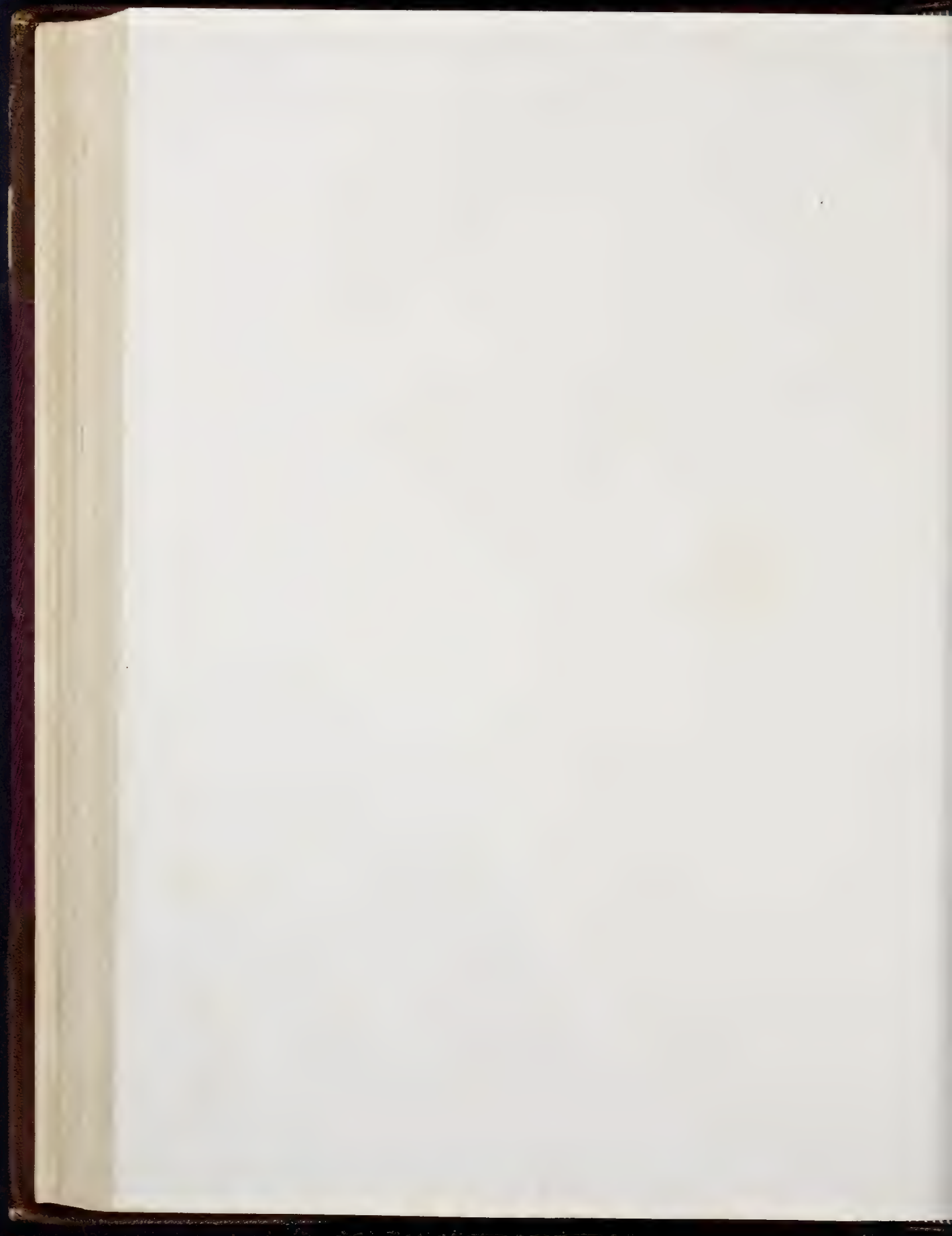
HALF TINT (Fr. *demi teinte*). This term has three meanings. In a monochrome, it embraces all gradations between positive white and black. In a polychrome, it expresses the primary colours, whether pure or mixed, if diluted with white into tints, or toned with black into shades; unless so wide a meaning be modified by a word limiting it to the tints (sometimes called *middle tints*) ranging between the positive lights and darks of the composition. Lastly, it is frequently used, in total forgetfulness of the meaning originally in France attached to the word, for any tint touched with black, or any shade touched with white: and this will probably remain the technical, as well as the popular, acceptance of the term.

HALI (EL MAESTRO) was in 1373 royal architect at Seville in Spain. Contemporaneously with D. Fernandez and J. Rodriguez, he was consulted upon an *azuda* or water works connected with the bridge over the Guadiana, and the mills belonging to the archbishop and the chapter of the Holy church, and to Doña Beatriz Gonzalez, lady mayoress. It is presumed that this Maestro Hali was a Moor, from his name; and as there still exist at Seville many works of that time which have an unmistakable Moorish character, some may have been constructed by him. 66.

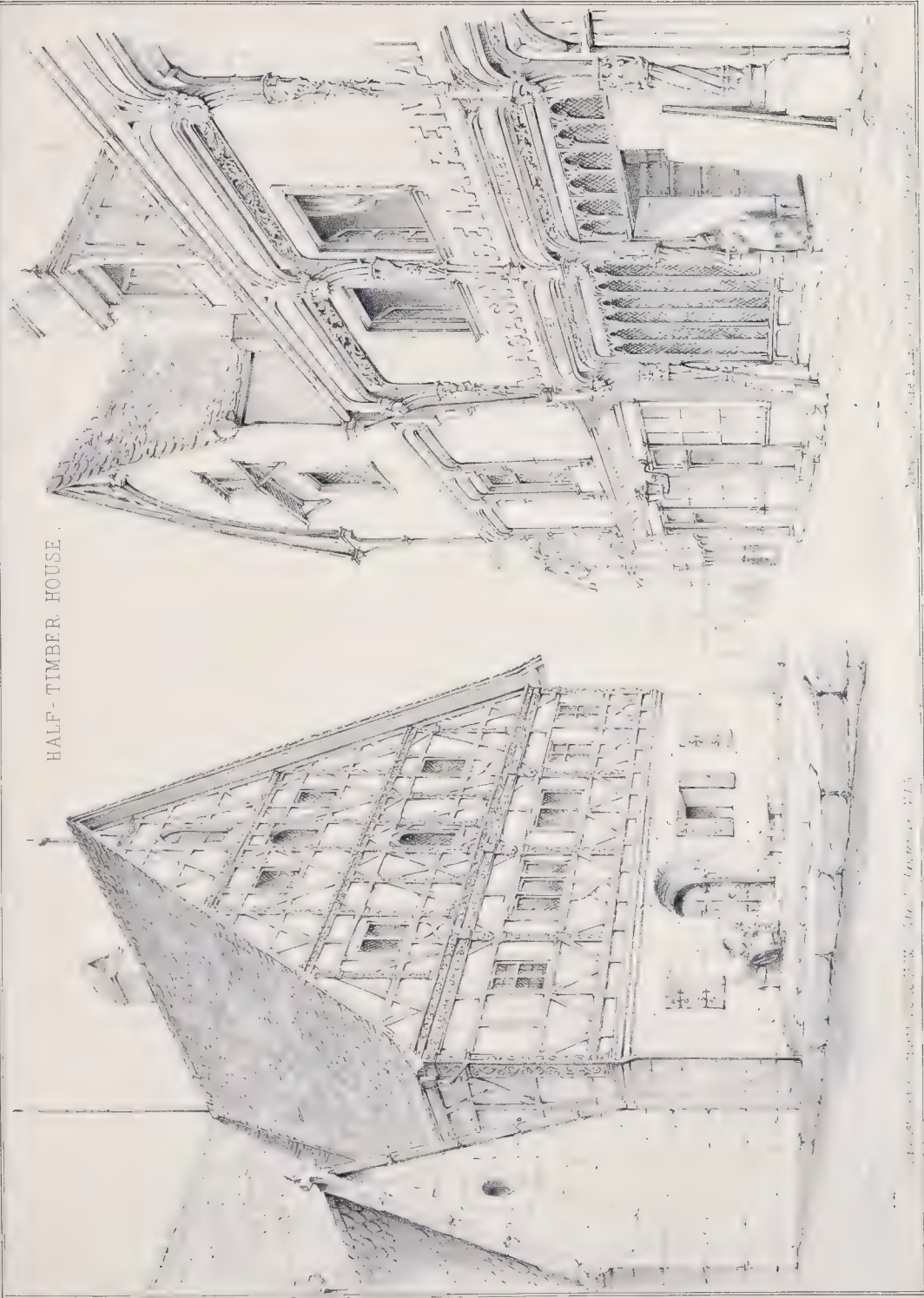
HALIA. A town in Arcadia in Greece, situated in a valley unknown to general travellers, between the lake Stymphalus and the Mount Trachys of Orchomenus. It was discovered in 1848 by professor Rangabe of Athens, and "presents one of the most imposing examples of Pelasgic architecture; at least two-thirds of it are in a state of rare preservation. Its form is that of a triangle whose base lies along the foot of the mountain, and whose two sides rise up on its flanks. The latter only are standing; the walls attain often a height of 16 ft., with thirty-seven square towers. A parallelogram traced on the summit of the triangle forms the acropolis of the fortress, whose walls are composed of gigantic polygonal blocks, and the lintel of whose doors consists of two inclined stones which mutually support each other"; RANGABE, *Ancient Greece, Notices of some Additions*, paper read before the British Association, at Edinburgh, August 1850; PAUSANIAS, viii, 23, places the town on that site; *CIVIL ENGINEER Journal*, xiii, 289.

HALICARNASSUS. A city, considered the largest and strongest in Caria, from its having two, if not three, almost impregnable citadels: portions of the Cyclopean and Hellenic walling indicate the course of the fortifications, and enclose the gardens of the present village of Budrum. The seat of government was transferred to this place from Mylassa by Mausolus, who died B.C. 353; whose tomb, commenced by his wife and sister Artemisia, who died 351, was accounted one of the seven wonders of the ancient world. The results of the recent researches, as given in NEWTON, *History of Discoveries*, London, 1862-3, were, lamps and statuettes of terra cotta; portions of Greek tessellated pavements, with the peculiarity that where broad stripes of colour were used they were made separately, and when fitted to the rest of the work had the joints run with lead; fragments of painted stucco walling and cornices; the plan of a Roman villa about 90 ft. by 115 ft., with its pavements so perfect that (inclusive of one 40 ft. by 12 ft.) the portions removed for transmission to England filled fifty cases; and, in their original locality, the remains of the mausoleum. These showed that the site was nearly opposite



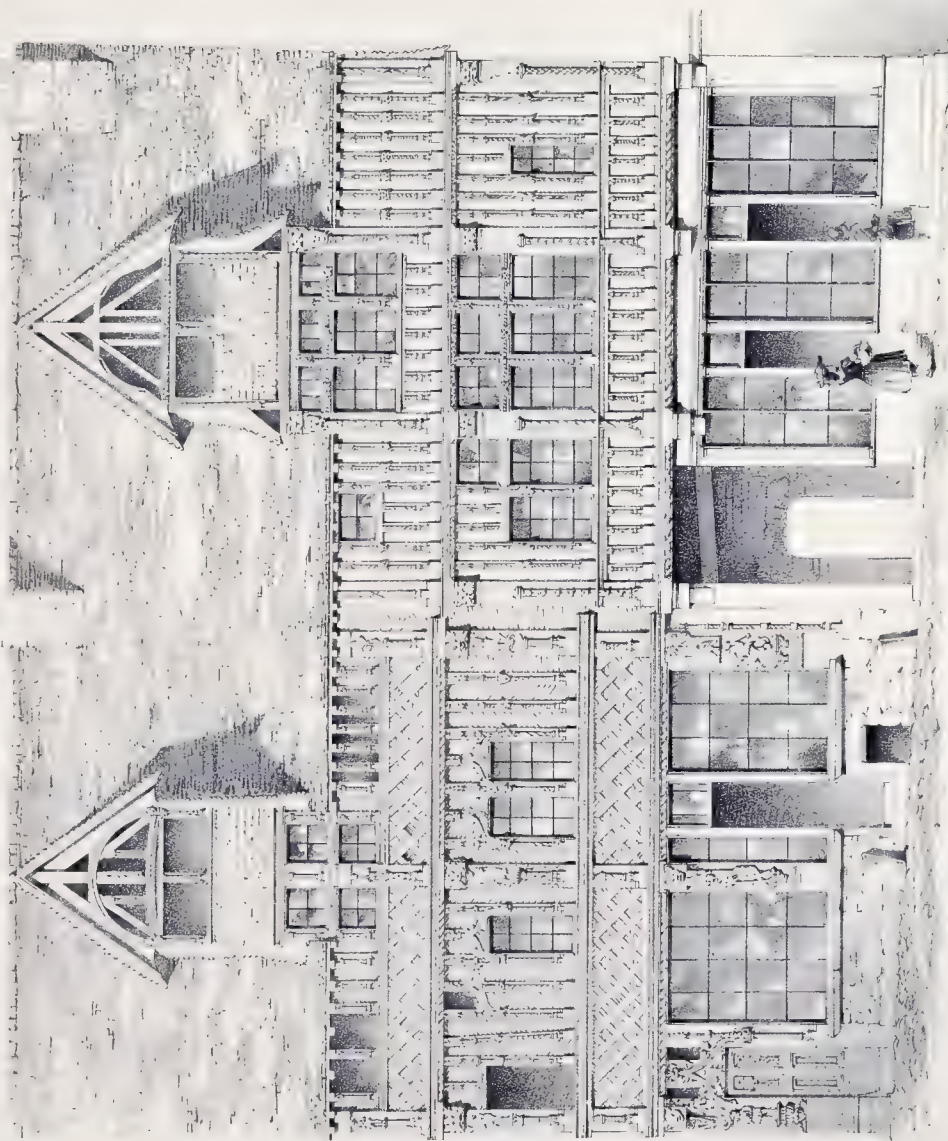


HALF-TIMBER HOUSE.



Architectural Publication Society
1887
No. 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100





House of Representatives

W. H. H. 1867



to the centre of the quay of the harbour, and on the south side of the great street which would divide it from the theatre and the Doric columns (called by NEWTON the portico of Apollo), north of which are the ruins of the building of an Ionic order which has been called the temple of Mars. Some remains of an edifice of the Corinthian order are hardly to be deemed to indicate the still unknown site of the temple to Venus and Mercury, or rather to Hermaphroditus. It seems remarkable that nowhere in the fifty plates, nor in the text except ii, 265, of the work in question, is there any revision of the illustrations or notice of the theatre and the building of a Doric order given in BEAUFORT, *Karamania*, 8vo., Lond., 1818, p. 95; HAMILTON, *Researches*, 8vo., Lond., 1842, ii, 31; and CHORSEUL-GOUFFIER, *Voy. Pitt.*, Paris, 1842, i, 247-65, pl. 96-101. The theatre is described as being about 280 ft. in diameter, the *diazoma* perfect and 2 ft. high, separating fifteen rows of seats below it from twenty more, which upper seats only are divided by radiating steps into *cunei*. The Doric building, possibly the temple to Mars, of the Roman times, is noticed as having still 140 ft. of colonnade, of which six columns, buried to within 6 ft. of their capitals, still carried their complete cornice; the columns were faceted, not fluted, and had a top diameter of $2\frac{1}{4}$ ins. at 7 ft. 6 ins. apart from centre to centre. A view of the modern fortress at the entrance of the harbour is given by the SOCIETY OF DILETTANTI, *Ionian Antiquities*, fol., London, 1797, ii, at the end; and in TEXIER, *Asie Mineure*, fol., Paris, 1839, ii, pl. 135. An Ionic pilaster capital is given by DONALDSON in the supp. vol. of STUART, *Athens*, etc. The description of the mausoleum, as decorated by Scopas, Bryaxis, Timotheus, Leochares, and Pythis, given in PLINY, *Hist. Nat.*, xxxvi, 5, has been the basis for attempts at the restoration of its design, of which about fifty have been published: the most recent are those in FALKENER, *Museum*, 8vo., London, 1851, i, 160, including that by Cockerell; by Pullan, in NEWTON, *Discoveries*, fol., London, 1862-3; and in FERGUSSON, *Mausoleum*, 4to., London, 1862.

HALIFAX STONE. The name sometimes given to the series of paving sandstones obtained in the immense parish of that name, though they are more generally known as Yorkshire flags, and Elland Edge landings. These flags are obtained in the greatest numbers at Northowram and Southowram, on the left or the east bank of the Hebble, which is rendered navigable as far as Halifax by vessels called 'billy boys' by which the stone is transported without trans-shipment to any part of the kingdom. The stone is quarried in one of the series of beds that lies immediately under the coal measures; it is hard, and resists the action of the frost if placed bedwise and exposed to constant wear; it is, however, easily detached in flakes; and so regularly does this occur, that 'natural faced' stones are often raised at once from the beds. The usual size of the stones that can be raised is about 5 or 6 ft. long, by 3 or 4 ft. wide, and 6 ins. thick. The Elland Edge stones, however, are obtained in very large landings; stones as much as 400 ft. superficial, and 1 ft. 2 ins. thick, have been obtained, and are much used for covering flat spaces or for landings, as they resist the action of the atmosphere even better than do the Halifax paving stones. A singular remark is to be made with respect to the durability of every description of Yorkshire stone; which is, that the surface is apt to pass away in flakes if there be no traffic over it, as though the friction developed some action in the stone that did not otherwise exist. There are no distinct experiments upon the resistance of Halifax stone, but it may be taken at about the rate of 7,597 lbs. on the square inch. Its composition consists of quartzose particles cemented together by an argillico-silicious cement.

At the International Exhibition of 1851 were shewn two blocks of very fine gritstone of a whitish cream colour, from the Shebden Head quarries. This stone is interposed between the Low-Moor beds of coal and the Halifax beds, which latter immediately overlie the millstone grit. A fine grained lami-

nated block of gritstone from Greentland, near Halifax, of a very light drab or cream colour was obtained from a bed lying below any of the known beds of coal. Other quarries are at Cromwell Bottom, Southowram, and Northowram, near Halifax. Some of these are excellent freestones with scarcely any mica; others contain mica, are laminated, and consequently better adapted for steps and landings. The Southowram stone has been employed extensively at the Bank of England; *BUILDER Journal*, ix, 685. ELLAND EDGE. G. R. B.

HALJRZEK (JAKOB), imperial royal *hofbaumeister* and burgess in the Altstadt at Prague, died in 1759. 20.

HALKIN LIME. A hydraulic lime manufactured at Holywell, North Wales. It is known for its strong cementitious powers for subaqueous masonry, for which purpose it was used in the construction of the Liverpool docks.

HALL. A very soft, coarse, open-grained, light wood of Ceylon, evidently adapted only for very inferior work, and where durability is not required. 71.

HALL (JERG VON), was *baumeister* after 1502 at Ulm cathedral. 92.

HALL (It. *sala*, *salone*; Sp. *sala*; Fr. *halle*, *salle*, *salon*; Ger. *saal*). This word is apparently derived from the Latin *AULA*, which was used in the middle ages in three senses: viz. for a large open or covered space; for a manor-house or hall house, perhaps because *aula-regia* meant a palace, so *aula* simply might mean a feudal lord's residence; for the principal apartment (perhaps as the court-room) in such a mansion, even when this "sovereign chamber" was on an upper floor, as at Lapworth manor-house, built 1314. It became the name for the principal room in any dwelling till nearly 1600; and for a vestibule.

The French, who formerly used the word *halle* for a market, have recently extended the application, *halle couverte* being the roofed portion of the roadway, and *halle des marchandises* the goods department at a railway station.

The English words *hall*, *court*, or *manor*, when applied to a house, at once suggest the idea that the building has been the residence of a territorial proprietor. It is probable that such a dwelling, called in late Latin *halla*, Anglo-Saxon *heall*, Norman *sale*, at first was merely a single capacious apartment that served as kitchen, living room, and bedroom; but the early addition of various appurtenances is shewn in the Harleian MS. 603 (tenth or eleventh century); and about 1177-1217 NECHAM, *De Nominibus*, Cottonian MS., Titus D xx, enumerates the hall, the chamber, the kitchen, the larder, the sewery, and the cellar: it seems clear that the cellar was on a level with the hall and beneath the chamber or *solar*, which had stairs to it inside or outside the hall. In the one large room specially termed the hall, till at least the middle of the fourteenth century, the owner and his household were to be found when at home during the day, unless they were in the chapel or the bed chamber: it served as audience chamber, as dining room, as dormitory (even so late as the middle of the fifteenth century), and sometimes as chapel, for example at Crook hall in Durham, and at Sutton Courtenay in Berkshire. The character of a parlour seems to have been taken from it before 1350; of a dining room in private houses at the end of the fifteenth century; and of an audience chamber before the year 1600; but for a reception room and for a vestibule the word still appears in plans; and remains in the term *SERVANT'S HALL*.

The mediæval hall, considered as a single room, recalls, in its purpose and use for the reception of dependents, the *basilica* of the Roman mansion. It usually occupied the whole, or the centre, of the front of the mansion; and in some cases it was placed over cellars or rooms, or even over a vaulted vestibule: the shape was usually that of a parallelogram, having at the upper end a raised pace or dais occupied on one side by a buffet, and on the other by an oriel window: the lower end was divided off for a width of from 6 to 10 ft. for a passage called "the screens", formed by a partition called a spur, in which were the entrances to the hall and the bars, hatches, or

serving places for the baker, the brewer, the cook, and the vintner; while above was an open gallery for musicians, or a second enclosed gallery. Windows placed high in the long walls, openings in the end walls from the upper rooms, and doors on the dais to the owner's chambers, with a louvre retained for ventilation after a fireplace opposite the oriel had superseded the hearth in the centre of the floor, complete the general description of such a hall, whether in colleges at Cambridge, Oxford, and London, or in houses like Crosby-place; sometimes the louvre was rendered impossible of construction by a dormitory or barrack room extending over the hall. Some halls seem to have been ailed, as at Leicester, and as it is said was the original plan of Westminster hall; while that of the Savoy hospital had for plan a Greek cross measuring 226 ft. each way, by 30 ft. in width. The hall at Lambeth palace, generally supposed to have been the last erected in England, was merely rebuilt 1660-3. So early as 1235-53 the hall was losing its character of being the usual dining room for the master, and in palaces the private banqueting room was introduced before 1525: the hall at Hampton Court has no dais, but has a dining room at the upper end; and at Wanswell Court in Gloucestershire the dais was at some time separated from the hall by a solid low screen for the sake of privacy. A large collection of plans of these mediæval halls is contained in TURNER and PARKER, *Dom. Arch.*, 8vo., Oxford, 1852-9, which, iii., 28, cites that of John Halle at Salisbury as being an example equally fine with that in any nobleman's house of the period. The furniture of these apartments, and the temporary halls provided for particular occasions, are detailed in HUNT, *Tudor Architecture*, 4to., London, 1836, who, p. 45, gives from BORDE and BACON, descriptions of the plans of mansions according to their ideas of the conveniences of their era. The HAMMER-BEAM ROOF was a peculiarity of the mediæval hall, as the caissoned ceiling, sometimes coved, is of the later structures.

The hall as a central saloon and as a vestibule seems to have formed part of buildings in all ages. Even in classic times those houses which were more than shops had a kind of apartment or passage, Gr. *θυρῶν, πυλῶν*, Lat. *ostium*, reaching from the entrance door as far as the *αὐλῆς, aula*, or *atrium*. Modern Italian houses show as a distinctive feature this central hall; it was adopted in France as a portion of the Renaissance; and lingered in English plans long after the Flemish style disappeared; while in our own times the classic *aula* reappears as a reception room in Stafford house and Ellesmere house, as well as in the Reform club house, and in the glazed courtyards of continental hotels, where there is really an outer or entrance hall (ANTEHALL) and an inner hall.

Reference should be made to the plans of houses and palaces given in PALLADIO; LETARQUILLY, *Rome Moderne*; and PÉRICIER and FONTAINE, *Maisons de Rome, et Palais, etc., de Rome*. The mediæval hall as a passage room appears in English plans perhaps first in PRICKE, *Art of Fair Building*, fol., London, 1670, where he translates LE MUET's *salle* or *salon* by *hall*. Besides the works mentioned above, many of the halls in the following list will be found represented in the publications by NASH; RICHARDSON; HALL and HARDING; CAMPBELL, *Vid. Britt.*; BRITTON, *Normandy*; etc.

By slow degrees this principal room has assumed the character of the Roman *ostium*, and is proudly termed a hall though only three feet wide, and not able to contain a porter's chair as a substitute for the *ὑποπόριον*, the *cella janitoris* of the ancients. One more resemblance remains; VIRGILIUS speaks of a door (rarely provided) from the *ostium* to the *aula*; and the present century has seen the introduction of swing doors to divide the passage into an outer and an inner hall.

The following list gives the dimensions of the chief large rooms of this kind, but it does not include many rooms built for music; MUSIC HALL. Those marked † have not been checked with good authorities: some have been destroyed.

| | | Length. | Width. | Height. |
|---|--------------------|------------|--------|---------------|
| | | Feet. | Feet. | Feet. |
| London, Westminster hall | - - - | 238 | 68 | N. end 67 |
| | to wall plate | - | - | S. end 42 |
| London, Christ's hospital | - | - | - | 90 |
| London, St. George's hall | - | 187 | 51 | 46 |
| London, custom house, long room | - | 186 | 61 | 44 |
| Durham castle | - | 180 | 50 | 36 |
| | formerly | 380 | - | - |
| Manchester, free trade hall | - | 176 | 104 | 70 |
| Windsor, St. George's hall | - | 175 | 32 | 30 |
| Liverpool, St. George's hall | - | 169 | 74 | 84 |
| Leeds, town hall (without hemicycle 113) | - | 162 | 72 | 75 |
| London, guildhall | - | 153 | 50 | 60 |
| | old roof | - | - | - |
| | new roof to ridge | - | - | 82 about |
| Glasgow, city hall | - | 150 | 65 | 34 |
| Birmingham, town hall | - | 140 | 67 | 65 |
| Conway castle, eight stone ribs, four exist | - | 129 | 31 | 22 |
| | - | 30 | 30 | 20 |
| London, Euston station | - | 125 | 61 | 60 |
| London, Lincoln's Inn, new hall | - | 120 | 45 | 64 |
| Raby castle, Durham | - (formerly 90) | 120 | 35 | - |
| Stirling castle | - | 120 | - | - |
| Oxford, Christchurch hall | - | 115 | 40 | 50 |
| Wells, Bishop's palace | - | 115 | 59 | 34 |
| Westminster, victoria gallery | - | 110 | 45 | 45 |
| York, great assembly room | - | 110 | 40 | 42 |
| London, Whitehall, banqueting room | - | 110 | 57 | 55 |
| Grinthurpe | - | 110 | 40 | 40 |
| Corsham house, Wiltshire | - | 100 or 110 | 25 | 25 |
| Bristol, divided by posts | - | 1108 | 50 | - |
| Hampton Court, Wolsey's hall | - | 106 | 40 | 60 |
| | - | - | - | walls 45 |
| Cambridge, Trinity college | - | 102 | 40 | 56 |
| Eltham palace | - | 101 | 36 | 54 |
| Richmond palace | - | 100 | 40 | - |
| London, Middle Temple, hall | - | 100 | 40 | 50 |
| | - | - | - | to cornice 31 |
| London, St. Katherine's Docks, long room | - | 100 | 60 | 50 |
| Chester | - | 99 | 45 | - |
| Westminster, house of peers | - | 97 | 45 | 45 |
| Windsor, Waterloo gallery | - | 97 | 47 | - |
| Southwark, Lambeth palace, now library | - | 93 | 33 | 50 |
| London, Freemasons' hall | - | 92 | 38 | 36 |
| | clear of galleries | 78 | - | - |
| Westminster, St. Stephen's hall | - | 90 | 30 | 60 |
| London, Mansion House, Egyptian hall | - | 90 | 59 | 60 |
| Lumley castle, Durham | - | 90 | - | - |
| Kenilworth castle | - | 88 | 45 | 32 |
| | - | - | - | 3 |
| Swansea | - | 88 | 30 | - |
| Oxford, Wadham college | - | 82 | 35 | 37 |
| London, Clothworkers' hall | - | 80 | 40 | 40 |
| Leicester castle, oak pillars | - | 78 | 51 | 24 |
| Oxford, New college | - | 78 | 35 | 40 |
| Spofforth | - | 77 | 36 | - |
| London, Goldsmiths' hall (with screen 80) | - | 70 | 48 | 35 |
| Partington, Durham | - | 70 | 40 | 44 |
| Arundel castle, baron's hall | - | 70 | 35 | 36 |
| Caerphilly | - | 70 | - | 35 |
| | - | - | - | 30 |
| Kedleston house | - | 69 | 42 | 39 |
| London, Crosby hall, Bishopsgate-street | - | 69 | 27 | 36 |
| London, Gray's Inn hall | - | 69 | 35 | 50 |
| Weyfield, Sussex, hall, stone ribs | - | 68 | 38 | - |
| Tordrich castle | - | 66 | 28 | - |
| Raglan castle | - | 64 | 27 | 42 |
| | - | - | - | walls 28 |
| Westminster, house of commons | - | 62 | 45 | 45 |
| Warwick castle | - | 62 | 35 | 25 |
| London, Lincoln's Inn, old hall | - | 62 | 32 | - |
| Beddington house | - | 61 | 32 | - |
| | - | - | - | to corbel 35 |
| | - | - | - | to ridge 10 |
| Berkeley castle | - | 61 | 32 | - |
| Swansea (second one) | - | 61 | 33 | - |
| Hill hall, Essex | - | 56 | 30 | 25 |
| Pawley, Northamptonshire | - | 54 | 24 | 43 |
| Blenheim palace | - | 53 | 44 | 60 |
| Vanstead house | - | 51 | 36 | - |
| Wotton-place, Surrey | - | 50 | 25 | 31 |
| royal palace | - | 37 | 66 | 47 |

FOREIGN HALLS

| | | | | | |
|--|---|-----------------|-------|-------|--------|
| Moscow, great riding house | - | - | +544 | 235 | — |
| S. Petersburg, riding house | - | - | -1335 | 162 | — |
| Padua, salone di ragione | - | { north side | 261.7 | 88.10 | E. end |
| | - | { south side | 257.3 | 87.10 | W. end |
| | - | { on the square | 261.7 | 88.10 | across |
| Florence, palazzo vecchio | - | - | 176 | 72 | — |
| Vicenza, sala della ragione | - | - | 169.6 | 69.4 | 88.7 |
| Bologna, palazzo vecchio | - | - | +170 | 74 | — |
| Mehur sur Yèvre, palace of duke John, burnt 1695. No columns | - | - | 156 | — | (60) |
| Rouen, salle des procureurs | - | - | 135 | 57.3 | — |
| Paris, grande meuble, now the admiralty | - | - | +120 | 70 | — |
| Caen, S. Etienne, salle des gardes | - | - | 108.3 | 30.10 | — |
| Rouen, cour des assises | - | - | 70 | 43 | — |
| Paris, palais des thermes, cir. 357 | - | - | +58 | 56 | 40 |

HALL. A term applied to the earlier colleges, at Oxford and Cambridge, which were constructed on a plan resembling that of a great mansion (a fact supported by TURNER and PARKER, *Dom. Arch.*, 8vo., Oxford, 1851-9); a system carried out to the reign of queen Elizabeth. At the opposite end of the hall to the screen was the dais, and beyond that, one large chamber better than the others. This latter, or parlour, was a common room for the scholars, and the only room in which there was a fire; here the college business was transacted, and above it was the master's chamber. As there were no chapels, the students had to go to the parish church, and consequently every founder first obtained a site abutting upon a church, then the advowson so as to control the hours of service; in some instances a covered corridor connected the hall with the church. In the fifteenth century, Corpus Christi erected a small chapel in its own precincts. To the first Michael house was erected S. Michael's church, in the nature of a college chapel and parish church; the choir of which projects into the nave in a remarkable manner, and is nearly in its original state. Queen's college, commenced in 1448, is a fine example of a collegiate building; it is all of brickwork, and shewed a complete analogy in its arrangements with those of Haddon hall; WILLIS, as reported in *BUILDER Journal*, from the CAMBRIDGE CHRONICLE, 1860, xviii, 359. COMMON ROOM.

HALLAM (JOHN) was secretary to H.M. Board of Works from 1723 to 1726, and clerk of the works at Whitehall, S. James's, and Westminster, from 1723 or earlier to 1727 or 8, when he was succeeded by H. Flitcroft.

HALLAN. A term used in Scotland for an inner or screen wall in old cottages, built between the fireplace and the door, extending from the front wall backwards, as far as is necessary to shelter the inner part of the house from the wind when the door is opened. It is generally composed of stone and clay to the height of the side walls and brace; at this height begins the mud or cat and clay wall, which is carried up to the chimney top. 109.

HALLER VON HALLERSTEIN (CARL FREIHERR) of Nürnberg. In 1808 he studied at Rome, at the time when Baron von Stackelberg, Ritter Brönstedt, M. T. Linckh, and G. H. Koes, were preparing to start on their scientific journey to Greece. Haller accompanied them, and in 1811 they were joined at Athens by the late C. R. Cockerell and J. Foster, architects. They all subsequently took an active part in the explorations and excavations at Ægina, Bassæ, Carthæa, etc., which resulted in the discovery of the statues of the temple generally attributed to be that of Zeus Panhellenios in the island of Ægina; and the sculptures of the temple of Apollo at Bassæ in Arcadia. The first are now in the Glyptothek at Munich; the latter, known as the Phigaleian marbles, in the British Museum. Haller was pensioned at Athens by the Bavarian government, and his drawings and collection were purchased after his death in 1817 at Ampelachia, on the hill of Ossa, near Athens, and are now at Munich. *QUARTERLY JOURNAL OF SCIENCE*, etc., 8vo., London, 1819, vii, 229. 68.

HALLING or HALLYNG. The set of hangings for the walls of a hall; SURTEES SOCIETY, *Finchale Priory*, 8vo., Newcastle, 1837, pp. 283, 432, citing the Durham Fabric Roll.

HALLING LIME. A species of flare lime obtained from the same beds that yield the ordinary stone lime which is used in London. It is moderately hydraulic, and contains from 6 to 10 per cent. of silicate of alumina. Halling is situated on the left bank of the Medway, in the same district as Rochester, Merstham, Dorking, etc., and the same description of limestone is also found at Burham, on the opposite side of the river. The lime partakes of the same qualities as that which is obtained at those spots. DORKING LIME. G. R. B.

HALLIWELL STONE. A stone obtained at Woodhead-hill, or Lomaxwood rock, and found lying immediately under the salts or best coal of New Mills; it is much used in building at Manchester.

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HALLMANN (ANTON) born in 1812 at Hanover, was placed with the *baumeister* Hellner, and subsequently studied in Munich at the academy and the *architekten-verein*. In 1833 he visited Italy; and at Rome became acquainted with W. Schultz of Dresden, for whom he made the drawings of the work *Normannische und Staufische Bauwerke in Kalabrien, Apulien und Sicilien*, fol., Darmstadt, 1845-6. After four years he returned to Germany, and constructed many buildings under Gärtner at Munich. He next went to S. Petersburg, where he directed some works under the chevalier Montferrand, for whom he made drawings for the decoration of S. Isaac's church. Proceeding on to Moscow, he made himself acquainted with the Byzantine-Russian style of church architecture. He then travelled through Denmark to England; and wrote a treatise on the *History of the Greco-Russian Ecclesiastical Architecture*, which he delivered at the Institute of British Architects 20 January 1840; it is given in *Transactions*, 4to., London, 1842, 88; and the greater part in the *ATHENÆUM*, 15 February 1840; the medal of the Institute was awarded to him for the paper. He submitted a design in competition for the royal exchange, London; and went on to Paris, where he submitted his drawings of the Calabrian and Sicilian structures to the Société des Arts et Métiers, which rewarded him with a gold medal. Returning to Prussia, he was presented to the king at Berlin, to whom he submitted a scheme for a Protestant cathedral. The king gave him the place of *hofbauinspektor*; but as he would not submit to the usual examinations, he resigned the office. He again visited Rome in 1841, where he became acquainted with his countryman F. Osten; and apparently renounced architecture, turning his attention to the other arts; OSTEN, Notice on Hallmann, given in the *Kunstblatt zum Stuttgarter Morgenblatt*, 1846. With regard to the many essays, treatises, and pamphlets, which he wrote alternately at Rome and in Germany, where he returned in 1842, their chief subject seems to have been that of art from a higher point of view: but few of them have been published. Yet perhaps the pith of them may be found in his *Kunstbestrebungen der Gegenwart*, Berlin, 1842, which contains also the explanations of his two designs, a Protestant cathedral, and a building to contain the different government offices in Berlin. From a critical notice of this book by Jakob BURCKHARDT, 1842, it appears that in both these works the author showed his invincible desire to erect something colossal. GRUPPE, Berlin, 1843, also published other critical observations on the plans for the cathedral. Hallmann returned 1843 again to Rome, where he occupied himself with a large painting intended for presentation to the king of Prussia, when he was attacked with fever; but refusing to postpone his habitual journey through Italy, he sailed to Leghorn, where he died on the 29 August 1845, aged 32 years. 115.

HALMENDORA. A hard, fine, close-grained, and heavy wood of Ceylon. 71.

HALMILILE. A rather soft, though fine, but not very close-grained, heavy wood of Ceylon. 71.

HALO (Lat. from Gr. *ἅλως*, a circle). The plain or radiant circular band around the head, by which, in the arts, the Saviour and the saints are distinguished; and which, in paintings, is usually gilded. It is sometimes represented by a circle of stars. GLORY; NIMBUS. J. W.

HALPACE and HALPAS, see HALFFACE and HAUTPAS.

HALSOO. A yellow coloured wood of Canara, East Indies, used in building and for furniture. 71.

HALVING. The method of joining timbers that cross each other by cutting out of one piece so much towards its centre as will allow the corresponding part of the other piece similarly treated to fit into and pass beyond that centre. It has been considered preferable to mortising, even when the timbers do not pass each other, as the work is less liable to injury from shrinkage. When fitted they are spiked together, and then described as "halved and spiked through". The halving is

done in three ways, 'common' or 'square', 'bevelled' on the beds, and 'dovetailed' at the sides; BREES, *Dict.* CAULKING.

HAM, or HOUGH AND HAM. The term familiarly given to punched irregular jointed Dalkey granite ashlar work.

HAMADEO (It. AMADEO and OMODEO), see HOMODEUS (G. A.)

HAMBURG (Lat. *Marionis*; *Hamburgum*; It. *Amborgo*; Fr. *Hambourg*). The first of the Hanse towns in Northern Germany, the capital of a small republic of the same name, and one of the most important commercial ports on the continent of Europe. It is situated on the river Elbe, about eighty miles from its mouth; there are no docks, but two enclosed *hafens* or harbours, the outer one for large vessels, the inner for smaller craft; the cargoes are discharged into barges, and transferred to the warehouses by means of the canals which intersect the streets. The city was once strongly fortified, but the earthen ramparts have been levelled and converted into roads and promenades. The small river Alster forms two lakes on the north-east of the town; the outer one, called the *Grosse Alster*, and the inner one, the *Binnen Alster*. The latter, of a square form, surrounded by broad planted walks, called the *Alsterdamm*, the old, and the new, *Jungfernstieg* (maiden's steps), is lined with good houses, and is considered as one of the principal ornaments of the place. The city was formerly divided into the *Altstadt* and the *Neustadt*, but these were united in 1615; and there are two old suburbs, S. George and S. Paul: since the fire extensive suburbs have been built outside the Dammthor on the north, and on the Hammerbrook on the south-east. ALTONA, the chief city of Holstein, adjoins the suburb of S. Paul. Hamburg is surrounded by a water-ditch 120 ft. broad and 10 ft. deep, and is entered by eight gates. The streets, especially in the southern part, are narrow, crooked, dark, and intersected by canals; of the numerous small bridges, only nine are of any importance. There are still a few good specimens of the old houses of the wealthy burghers, in which the warehouse was combined with the dwelling house; some of these are half-timbered houses, with effective carving of the early Renaissance style; several very good stone fronts may also be found, decorated with the Renaissance adaptation of the orders to the different stories, and with lofty gables; the best example is the *kaisers-hof* in the Grosse Reichen strasse, dated 1619. Since the great conflagration of the 5-6-7th May 1842, by which 76 streets and places and 1,749 houses were destroyed (ILLUSTRATED LONDON NEWS, i, p. 1-2), this portion has been rebuilt on a well arranged plan laid down by a commission of which the late A. de Chateauneuf, arch., was president, assisted by W. Lindley, C.E., of London; the new streets are of fair width, well paved with granite, and the whole town lighted with gas; many of the new houses are of considerable architectural merit. A complete system of sewerage was at the same time planned and carried out by W. Lindley, the houses formerly draining into the canals; as detailed in the ALLG. BAUZEITUNG, 1846, pl. 72-6; which also, 1847, pl. 110, exhibits the water supply designed by Messrs. Lindley and Milne of London; these are detailed in FABER, etc.: the gas works by W. Lindley, 1846-50, are given in the CIVIL ENGINEER Journal, xv, 24. The monument of iron, cast at Berlin, erected 1227 to Adolphus IV, count of Schaumburg, was transferred 1840 from the place of the same name, to the gardens near the Steinthor; it consists of four columns supporting a canopy: the obelisk of reddish sandstone 20 ft. high, 1802, to professor Büsch, is near the great Alster bridge: the Repsold monument, 1830, by Chateauneuf, is near the Millernthor: a statue of Schiller is to be placed in front of the new picture gallery 10 November 1864, and is to cost about 16,000 Prussian dollars, or £2,300; and an antique sarcophagus of sandstone, 11 ft. long, 6 ft. wide, and 7 ft. high, erected to the memory of the banished and fallen citizens during the siege of Hamburg, is now on the Dammthor.

Of the public buildings remaining after the fire, and of those

that have been rebuilt, the following deserve notice. The great S. Michaelis-kirche (untouched) in the Neustadt, 1751-62, by Sonnin except the spire, which was not completed till 1778; FABER says 1762-86; it is a cross church 245 ft. long and 184 ft. wide, and capable of accommodating upwards of 2,000 persons; it has a spire 456 or 460 ft. in height, one of the loftiest in Europe, a fine portal, a vaulted ceiling, an altarpiece by Tischbein, and a fine organ. S. Petri-kirche, rebuilt (except the tower) 1844 by Chateauneuf and Fersenfeldt, is 225 ft. long and 135 ft. wide, and is a lofty Gothic structure, containing an altarpiece by Bendixen, with many good paintings by Coignet and others. S. Catharinen-kirche, with a tower 390 ft. in height, is 250 ft. long and 100 ft. wide; has a fine window 45 ft. in height, 14 ft. 6 ins. in width, one of the most splendid glass-paintings of the Munich institute, by Overbeck, representing Christ teaching the disciples; and contains a pulpit, and many good paintings. S. Jacobi-kirche, erected 1354, is about 220 ft. in length and 120 ft. in width, and contains many paintings; the tower, the upper part of which is modern and of wood covered with copper, is 355 ft. in height. S. Nicholas-kirche, commenced 1845 and consecrated 25 September 1863, was designed and carried out by G. G. Scott of London, in the German Pointed style of the end of the thirteenth and beginning of the fourteenth century; the nave is 83 ft. wide and 100 ft. high to the underside of the groining, which is filled in with brick; the transepts are 36 ft. 6 ins. wide; and the whole building is about 300 ft. long: the western tower is 46 ft. 6 ins. square above the plinth, which with the spire hereafter to be constructed, will be 460 ft. high; an octagonal baptistery is to be attached to the tower. The materials used are the yellow bricks of Schleswig, fine gritstone from Osterwald near Hildesheim, and a coarser gritstone from Postlewitz in Saxon Switzerland. The font, reredos, and pulpit were executed in London. It will seat nearly 3,000 persons; the whole cost has been about 200,000 marks: the BUILDER Journal, xvi, 438, gives an interior view, at which time, 1858, the building was up to the wall plates: the ILLUSTRATED LONDON NEWS, 1848, vii, 91-2, gives a view, etc.; the BAUZEITUNG, 1848, pl. 171, gives a plan of it with the surrounding blocks of buildings. There are seven other churches, a Jewish temple, and two synagogues. There are several cemeteries situated outside the town.

The *börse* or exchange, considered one of the best buildings of its class, not excepting that at Paris, was designed by Forsmann and completed 1841 by Wimmel, the city architect; it was untouched by the fire; the hall is 124 ft. 6 ins. long and 70 ft. 6 ins. wide, exclusive of the colonnade, which is double at each end and treble at the sides; a broad open gallery runs round it, and communicates with the reading and refreshment rooms. The whole length of the edifice is 226 ft. 6 ins., and its width 174 ft.; since its completion arcades 230 ft. in length have been added on both sides, for the more complete accommodation of the public, by Chateauneuf (EXCHANGE, p. 65). The bazaar, or the *passage* of W. Sellim, was designed by Averdieck; it faces the old Jungfernstieg, and is 124 ft. in length; the depth is 352 ft.; the spacious interior arcade, having a curved iron and glass roof, is 200 ft. long; BAUZEITUNG, 1848, pl. 190. A new museum of Fine Arts is in course of erection, 1864, from the designs of F. Laciész.

The new post office by Chateauneuf, built 1842-7, combines four postal departments; it has a frontage of 275 ft., a depth of 87 ft., and is 65 ft. high; the tower, 150 ft. high, formerly a telegraph, adjoins on the east side: the observatory is of granite: of the three theatres, that called the *stadt-theater* was built after the designs of Schinkel of Berlin: the *ton-halle* has the largest concert room in the town, being 123 ft. long, 65 ft. wide, and 40 ft. high: the *stadthaus* is one of the largest and most tasteful of the old buildings of Hamburg; it was erected 1722 by baron von Görtz, the envoy of Charles XII, king of Sweden, and was purchased in 1806 by the city from his heirs

for the residence for the imperial ambassador, but is now used as offices for the city police and other boards: the *bauhof* was built in 1675: the *kornhaus* 1610 is now used as barracks: the gymnasium or high school, by Wimmel and Forsmann, completed 1840, is in a quasi-Byzantine style, each wing is 175 ft. long and 44 ft. wide, the library has nearly 200,000 volumes with about 5,000 MSS.; *BAUZEITUNG*, 1839, 292-4: the Johanneum or Latin school adjoins it. There are several well endowed hospitals, one providing for 500 orphans; a general hospital or infirmary for from 4,000 to 5,000 persons; the S. Johannis-kloster, consisting of ten dwellings for twenty widows, was rebuilt 1836, and is 276 ft. long; the *krankenhaus* or common hospital, founded 1823, is 703 ft. long, the wings 330 ft., accommodates 1,500 beds; the *Schröder'sche-stift*, completed 1852, for widows and their families; the Jews have similar establishments: the meat market by Forsmann, *BAUZEITUNG*, 1847, pl. 119: an aquarium 1863-4 in the zoological gardens is said to be at least three times larger than any other; it is by Meuron and Haller, under the advice of W. A. Lloyd of London; it is 64 ft. long and 34 ft. wide; *BUILDER Journal*, xxii, 569; and the building of the Patriotic Society (for the Encouragement of Arts, etc.) by Bülow, an adaptation of the peculiar brick style of North Germany; complete the list of noteworthy structures. Early in 1855 a commission was appointed to obtain designs for a new *rathhaus*, or hôtel de ville and senate house; in February 1856 the premium of 350 Fred. d'ors was awarded to G. G. Scott of London (Gothic); 250 Fred. d'ors to A. Meuron of Hamburg (Renaissance); and 250 Fred. d'ors to L. F. C. Bohnstedt (Gothic): the plan and view of the first named design is given in the *BUILDER Journal*, xiv, 63. The railway bridge proposed 1860 to be constructed over the two arms of the Elbe between Harburg and Hamburg was designed 3,300 ft. long; the left arm 2000 ft. long consisted of six arches, each 333 ft. 6 ins. span, with the rails 9 ft. above the highest tide level, or 18 ft. above high water mark. The right arm 1,300 ft. long, was of five arches, each of 325 ft. span; *BUILDER Journal*, xviii, 51-2.

All the dimensions except those of the exchange are in Hamburg feet, of which one equals 0.94021 English. A plan of the town is given in the *Maps of the Society for the Diffusion of Useful Knowledge*, No. 182. FUCHS, *Hamburg's Neubau*, fol., Hamb., 1846, contains 60 plates of the façades, and 40 of the details, of the new buildings. Some houses are given in the *BAUZEITUNG*, 1841, pl. 381-2; 1846-8, pl. 69-79; (80-4; 85-6, the hall of the tailors, 91-3, all by Chateaufneuf); 109; 169; 191; and 207-8: pl. 108 and 120, are near to the city. DEMIDOV, *Voy. Pict., etc., en Russie*, etc., fol., Paris, 1840-7, pl. 5-8; and LANGE, *Original Ansichten der — Deutschland*, 4to., Darmstadt, 1843, give views of the old buildings. *Handbuch für Reisende*, 8vo., Altona, 1858; WALLACE, *H. Guide*, 16mo., Hamburg, 1854; *Rules and Orders for Suppressing the rage of Fires*, in *H. and Amsterdam*, 8vo., London, 1715; ZAHN, *Ornamente enthaltend eine reiche Auswahl von Capitülen, etc., aus den neubauten Hamburgs gesammelt*, fol., Hamb., 1848.

HAMELIN (HANS) built the so-called *baumhaus* in 1622, one of the oldest buildings in Hamburg, at the end of the Steinhöft, pulled down for the improvements in 1857; *BUILDER Journal*, xv, 153.

HAMELIN'S or HAMLIN'S CEMENT or MASTIC. A description of cement whose exact composition is not known, but which in all probability is comprised of about 93 parts of burnt clay, with 7 parts of litharge (the red protoxide of lead), ground together to the consistency of a fine powder, and subsequently mixed with linseed oil. It is applied like plaster, after the surface of the brickwork has been thoroughly wetted with a sponge filled with oil. In practice it has been found that the oil has oxidized, and the material decayed so fast, that its use has been now almost abandoned. It was much used in the new buildings near Norton bridge in 1835-6. G. R. B.

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This cement is evidently, chemically, nothing but a coarse paint.

NICHOLSON, *Dict.*, notices its composition as consisting of one cwt. of pounded stone, silver sand, litharge, and red lead, mixed together with a gallon of linseed oil. This stucco, when mixed with linseed oil to the consistency of damp sand, will adhere firmly to ironwork and to glass which has been previously covered with *boiled* linseed oil; it is said to require an expert workman to use it. The mode of working it is stated to be very different from that of Sheppy cement by DONALDSON, who describes it s. v. *Stucco*, etc., in *Encyc. Metrop.*, 1840, p. 177. GWILT, *Encycl.*, says that it was an invention by Lorient, a century ago; that it requires great experience and care in using; that a coat of it should never exceed one quarter of an inch in thickness, it being therefore unfit for working moldings in the solid, which are roughed out in Roman cement, leaving an eighth of an inch for the mastic; and that "so used it not only presents a beautiful surface, but is very durable." This mastic was first employed in London about 1821, by John Nash at the Haymarket theatre, which a few years since was much out of repair; his own house in Regent-street was finished with it, and has since been frequently repaired. CEMENT. 1.

HAMHILL STONE. The stone which forms the subject of this notice is chiefly worked at Stoke-sub-Hamdon, situate about five miles west of Yeovil in Somersetshire. It belongs to the inferior oolite, and is found capping an outlier of that formation which rises above the lias with bold escarpments on the north and west, presenting itself on the north at West Stoke in a narrow tongue of land, which on the east extends into a table land towards Montacute of less than three-quarters of a mile in breadth, while on the south its greatest length is scarcely a mile in the direction of Norton-hill. Its position with regard to the lower beds may be seen by the following section in descending order:

| | Feet. |
|--------------------------------------|-------------------|
| 1. Inferior oolite of Stoke | 88.0 |
| 2. Sands of inferior oolite | 50.0 |
| 3. Upper lias | 4.0 |
| 4. Middle lias, marlstone | 4.0 |
| 5. Middle lias—lower marls, probably | 100.0 |
| 6. Lower lias | thickness unknown |

Looking down from Stoke-hill, an extended plain of the lower lias may be observed stretching away towards Ilchester, Somerton, Langport, and Bridgewater, where the latter formation is extensively worked for paving stones and other purposes. The Middle lias comes up to the base and passes under Stoke-hill, and the upper zone, the marlstone, No. 4, is the chief material used for the roads of the district. This band is but from 3 to 4 ft. thick, and is the precise equivalent of the Cleveland and other ironstones of Yorkshire, though here it is not rich enough to be worked. The Upper lias, No. 3, of 4 ft., is the diminished representative of beds of very considerable thickness in the North. The yellow sands, No. 2, below the workable beds of oolite, are called 'Brim Sands', and are about 50 ft. thick, with occasional concretionary boulders of sandstone. Immediately on the above repose the beds, No. 1, for which these quarries have been for so many centuries worked. The largest quarry-masters at this time are the Messrs. Staple and Messrs. Trask. The greatest development of the beds is in an open quarry worked by Charles Trask, which in ascending order gives the following section:—1. *Bottom Bed*, a hard nodular bed, not extracted 1 ft. 4 ins. thick. 2. *The Grey Beds*, four in number, of an average thickness of 2 ft.; 2 ft. 6 ins.; 2 ft.; and 1 ft. 8 ins. These are divided from the *Yellow Beds* next above, No. 3, by a coarse bed about 1 ft. thick, which contains small pellets of iron ore. The *Yellow Beds* vary from 2 ft. to 1 ft. 6 ins. in thickness, and are of the same general character, and all closely bedded; the upper members of the group being the hardest. The whole of the workable beds to this point give 58 ft. of solid stone. These are surmounted by

about 30 ft. of what the quarrymen call 'ochre', No. 4, which is only a yellow sand, sometimes passing into a sandstone, above which are 4 ft. of vegetable soil and rubble.

Although the *Yellow Beds* yield a very good building material when carefully selected, still the *Grey Beds* at the base of the series are most to be depended upon for weathering equally, and for the finest quality of building stone. In consequence of a slight dip in the beds from north to south, the latter come to the surface at Joseph Staple's quarry on the north side of the hill, and are therefore more easily extracted. It is not improbable, in consequence of the thickness of the heading in the virgin ground from which before long the stone must be obtained, that it may be slightly enhanced in price; but at present the best quality is rendered at an average price at the quarry of 1s. per cubic foot. These quarries are known to have been worked from the time of the Norman Conquest, and there can be no doubt the hill promises a supply of stone, even though very largely worked, for many centuries to come. It is remarkable that in almost every locality these lower oolitic rocks possess special characters, and are of very varying thickness, indicating different conditions of the sea bottom of the period, and in the material of which the rocks are composed. All the workable beds at Stoke-sub-Hamdon may be said to be entirely composed of finely comminuted shells held together by a cement of carbonate of iron. Notwithstanding the enormous mass of organic matter thus brought together, perfect remains are very rare. It is a warm soft brown in colour, containing an average of 14 per cent. of metallic iron. The stone has been very generally used in the district, both for mansions and ecclesiastical purposes. Of the former, examples may be seen at Sherborne castle; Montacute house; Barrington court; Hinton house, etc.; and of the latter its enduring character is shewn by Ford abbey, dating from the Norman Conquest, and Cerne abbey, which are still in good condition; Sherborne abbey; Montacute priory and abbey; Milton abbey; and in the churches of Huish, Yeovil, Crewkerne, and Ilminster. It is also extensively used in combination with some other materials in the structural portions, for such ornamental work as dressings, the tracery of windows, etc., as in the church of S. Mary Magdalen at Taunton. Long before the introduction of railways it had been used in churches as far off as Tiverton and Collumpton. Although the railway passes within a short distance of Stoke-hill, the stone is still conveyed by waggons to its destination. A siding between Martock and Yeovil might be constructed about a mile from the quarries, and there appears no reason why the stone should not then command a market in the metropolis, for the requirements of which it appears well adapted. (C. Moore, esq., F.G.S., Bath.)

A few years since, in sinking a well from the top of the hill to a depth of 120 ft., the following section of strata was made: 40 ft. of Ham stone; next about 80 ft. of what is termed *brim sand*, with strata of rounded boulder stones; the *upper lias*; and then *marl stone*. Between the masses of rock are many fissures, called by the workmen 'gullies', running across the hill, which appear to have been formed by a lift from beneath rending asunder the rock.

In building operations, care should be taken to specify the qualities of stone for use as follows:—All dressed stone to be of the best Hamhill stone worked and wrought on its natural bed, and to be so set in the building; all sills, heads, and lintels, to be of the grey stone, in long lengths, free from clay beds, iron veins, and other defects; the best yellow stone to be used for superior molded work and the less exposed portions, as will be directed.

R. H. S.

"Hampden quarry, nine miles from Melbury, Dorsetshire, the seat of the earl of Ilchester, is said to have supplied 3,000 loads of freestone", cir. 1509; NEALE, *Seats*, etc., 4to., London, 1828, 2nd ser., iv. Some references to its modern use will be found in the *BUILDER Journal*, xvi, 284; xv, 177; xviii,

484, 628; and 1851, ix, 747, notes that the stone obtained from the "lower oolite of Ham-hill (the short for Hamdon-hill) near Yeovil, is not so light coloured as those from the neighbourhood of Bath, but is of a light ferruginous brown, weighing (from 134½ lbs. to) 141 lbs. 12 ozs. per cubic foot. Its composition varies considerably from that of the other oolites, principally by containing siliceous and an admixture of carbonate of magnesia and iron alumina. The analysis is silica 4·7; carbonate of lime 79·3; carbonate of magnesia 5·2; iron alumina 8·3; water and loss 2·5; bitumen a trace. The disintegration was nearly as great as in the Bath stone, being one grain in 500"; as in the *Report on Building Stones*, 1837, which further mentions that at Montacute the parish church, fifteenth century, is of Hamhill stone in perfect condition, covered with lichens: of the abbey, fifteenth century, the supposed abbot's house and gateway is also in good condition: Montacute house, seventeenth century, in excellent condition: Martock church, fifteenth century, of a shelly ferruginous brown limestone from Hamhill, is in good condition except the plinth and base moldings, which are much decomposed; it is covered with lichens.

HAMILTON (SIR JAMES) of Fynnart, a natural son of James, first earl of Arran, had letters of legitimation in Jan. 1512-13, and afterwards became one of the chief favourites of king James V, who appointed him steward of the household and master of the king's works. In 1539 he was committed to Edinburgh Castle on a charge of inventing certain engines by which king James V was to be shot from the tower of Linlithgow, and for embezzling moneys paid to him for the repair of castles and palaces. He was tried, beheaded, and quartered in August 1540 on the Castle-hill. He was employed in building, extending, or repairing Falkland palace; Linlithgow palace; the north-west portion of Holyrood house, Edinburgh; the castles of Edinburgh, Stirling, and Rothesay; while his own towers of Craignethan on the Clyde, served to attest a skill which proved fatal to its master; *Transactions of Arch. Inst. of Scotland*, 8vo., Edinb., 1851, 60. ACT. PARL. SCOT., fol., London, 1814, ii, 362-3; ANDERSON, *Hist. of the House of Hamilton*; IRVING and MURRAY, *Upper Ward of Lanarkshire described*, etc.

HAMILTON (DAVID), born at Glasgow 11 May 1768, was at first educated for a carpenter or mason, but he eventually occupied a prominent position in that city. In 1803-5 he designed Hutcheson's hospital; 1804 he erected the Queen-street theatre; 1 Aug. 1806 the Nelson monument, an obelisk 144 ft. high; 1806-10 Gorbals church (Roman); rebuilt 1830 S. Enoch church (Ionic) except the steeple; erected 1817 S. John's church (Perpendicular); 1829-30 the royal exchange (Corinthian); 1835 S. Paul's church (Grecian Ionic); 1838 the normal school; 1840 the Hutcheson school; 1840 the Western club house (Italian); the Western, now the Clydesdale bank (Venetian), enlarged and altered by D. Bryce; 1841 the union bank, with his son JAMES; with his son-in-law J. SMITH the Exchange-square and Royal Bank-place buildings. He also erected the British Linen bank; the entrance lodge to the Fir park or necropolis, with the bridge spanning the valley of the Molendinar burn; and, his last work, 1843 the Glasgow and Ship bank. The number of well designed structures by him, especially in the west of Scotland, is very great; among them are, 1813 Crawford castle, not the priory, near Culter, Fifeshire; 1821 Castle Toward, Argyshire (Castellated Gothic), for the late Kirkman Finlay, esq., M.P. (NEALE, *Seats*, etc., vi, 1823); Dunlop house, Ayrshire (Scottish manorial), for Sir J. Dunlop, bart.; Airth castle, Stirlingshire, for T. G. Stirling, esq. (NEALE, 1826, 2nd ser., iii); completed in 1828 Hamilton palace, Lanarkshire (Grecian) for the duke of Hamilton (DIBBIN, *Northern Tour*, 8vo., London, 1838, ii, 798, etc.); and 1837-41 Lennox castle, Stirlingshire (Norman), for John L. Kincaid Lennox, esq., of Kincaid, which is considered Hamilton's best design. Amongst other

works, were alterations for the duke of Hamilton in Portman-square, London. He also obtained the third premium of £500 in the competition for the Houses of Parliament in 1835. Five hundred pounds in a gold box were presented to him at a public dinner in July 1840. He died at Glasgow 5 Dec. 1843, in the seventy-sixth year of his age. His bust in marble by Patric Park exists; and one by the elder Mossman, considered a better likeness, belongs to the family. *BUILDER JOURNAL*, i, 537. The late C. Wilson of Glasgow was a pupil. JAMES succeeded his father in practice, and died in 1862.

HAMILTON (THOMAS), R.S.A., F.I.B.A., born in 1785, practised at Edinburgh. He designed as 'T. Hamilton, jun.' in February 1820 the memorial to Burns near Ayr. At Edinburgh, he laid the first stone 28 April 1825 of the high-school (Grecian Doric) it was completed in 1829; (the specification is given in DONALDSON, *Handbook*, 8vo., London, 1860, 260); 1827 laid out the new lines of approach and thoroughfares on the south and west sides of the castle, including George IV bridge; 1831 erected the two churches at the entrance of the west approach (DONALDSON, 210); 1834 the pavilion for the Grey festival, 101 ft. square, seating 1,570 persons at dinner, 750 after, and 330 in a gallery on one side beyond the square, making a total of 2,650 to hear the speeches, as described in the *Transactions of the Royal Inst. of British Architects*, 4to., London, 1835, i, pt. 1, p. 65; 1833-6 the orphan hospital (Grecian); 1844 the monument to the political martyrs of 1793, an Egyptian obelisk; 1845 the new Physicians' hall (Italian); Dr. Guthrie's Free church; Dr. Reid's class room, a drawing of which is in the collection of the Institute; the town buildings and spire at Ayr; the parish church of Aylth near Perth; several Free churches and gentlemen's seats in different parts of the country; designed John Knox's church on the Castle-hill (not built); and restored South Leith parish church (Gothic). He published a Letter to the Right Hon. Lord John Russell, M.P., *On the Present Crisis relative to the Fine Arts in Scotland*, 8vo., 1850, giving his plans for the building of the Royal Academy on the Mound, for £22,000, and for the improvements there. He died in Howe-street, 24 February 1858, aged 73. Among the *Illustrations of Scottish Buildings*, 1863, by the Architectural Institute of Scotland, are given the elevations of the east and west sides of West Bow, Edinburgh, from his measured drawings. *BUILDER JOURNAL*, xvi, 146; xvii, 243; *GENTLEMAN'S MAGAZINE*, 1858.

HAMILTON (PETER), a son and pupil of the Thomas above named, was subsequently drawing master at the Birmingham school; he joined his father towards the close of his life; designed the new poor house for Leith, at a cost of about £7,000; and died December 1861.

HAMMAM MESKOUTIN, in Numidia, see AQUÆ TIBULITANÆ.

HAMMEL. A place appropriated, in the buildings of a farm, to the reception of horned stock kept to grow or to fatten. It is a shed from 10 to 20 ft. square, having on one side a court twice or thrice the size of the roofed space; the whole being drained to a sink in the centre of the court. In the northern counties of England each hammel serves for a couple or more beasts: those that are too young to be entirely at liberty are allowed to leave the shed for the court, and to return, at pleasure during the day; bullocks to be fattened for the meat market are more confined. Entrance to the open space is obtained by a doorway; in the fence dividing it from the farm-yard, according to the English custom; but in a narrow court which is divided by a wall or fence from the central portion of the farm-yard, according to the Scottish manner. If a range of hammels forms a long shed (also called a hammel), the partitions should touch the roof, according to STEPHENS, *Book of the Farm*, 8vo., Lond., 1851. Although ANDREWS, *Agricult. Engineering*, 12mo., London, 1852, i, 74, speaks of hammels as usual in many parts of the north of England and general in Scotland, yet such as those of Berwickshire (which

are smaller than those of Northumberland) became out of repute in Scotland, at least in East Lothian; because open sheds with large courts obtained preference for reasons given in LONDON, *Encyc. of Cottage Arch.*, 8vo., London, 1842, pp. 441 and 534. The latter writer observes that when short-horned cattle kept to fatten are tame enough for several to be put in a small space, hammels are useful; but that a month or more may pass before a purchaser of Highland stock will find it safe to leave even two or three of his recently acquired young and active beasts together in a hammel. On each side of the entrance, boxes are sometimes provided, in which each animal can be secured temporarily, or can be fed from the court or yard, unless a feeding passage along the whole length of the back of the shed be provided, as is desirable. The chief use of the hammel seems to be that growing stock, which will not thrive well if subjected to much confinement, are thus furnished in a moderate space with fresh air, shelter, litter, shade, water, and some freedom of motion; and that fattening stock, as regards health and condition, are under the immediate eye of the farmer, whose supply and distribution of provision to them is also facilitated. CATTLE SHED; FARM.

HAMMER, in Norway, see STORHAMMER.

HAMMER. A tool having a head fixed to a handle, in the same manner as a pickaxe. The instrument is so common that it is hardly possible to collect the different names and shapes which it has acquired. For *heavy work* smiths had the tilt (or trip) hammer, the fore-hammer, another somewhat lighter which may be the matyng-hammer (or mate to the fore-hammer), noticed by the SURTEES SOCIETY, *Finchale Priory*, 8vo., Newcastle, pp. 299, 437, and the hand-hammer, besides the nailing-hammer. But these large tools are to some extent superseded by the steam-hammer; patents for which were obtained by Watt and others, but the general use of it has arisen from the self-acting power of that invented by Nasmyth, which is described in the *PRACTICAL MECHANIC JOURNAL*, 4to., Glasgow, 1848, i, 77. In 1846 Condie obtained a patent for a steam-hammer where the piston or pistons are fixed, with the steam introduced into the hammer or cylinder (noticed in the same *Journal*, 1852, vi, 133, 191), which seems to have been the idea of Wilson's patent, 1847. The steam-hammers are unnecessary to be here described.

The forms of the adjusting-hammer, the dressing-hammer, the pin-hammer, and the wedge-hammer, may be seen in BREE, *Railway Practice*, 3rd ser., 4to., London, 1847, pl. 8-10. A set of tools used in the slate quarries is formed by the cleaving-hammers. Masons have the bit-hammer, square at one end for scapling, pointed at the other for pick-dressing, which is used for granite, limestone, or other hard stones: the DIAMOND HAMMER; the cavi, jedding-axe, scapling-hammer or stone-axe; the hammer-axe, which is a hammer-head on one side, and an axe on the other; and the patent hammer or GRANITE AXE. HARDNESS.

Masons also use a *mallet* either of wood or lead with their chisels; but in squaring paving, and other rough work, a stout heavy hammer with a short handle, called a *club-hammer*, is used. The bricklayer's hammer has a long head at one end and a cutting tool like an axe at the other. The plasterer's *lathing-hammer* is much the same, but lighter, and with a notch to draw out nails. The slater's hammer has a long head at one end, and at the other a pointed end or pick for holing the slates, and often a claw at the side of the head for drawing nails. The plumber's hammer has a long slender head with a long claw for drawing nails; and the glaziers use a lighter one of the same sort, called a *bradding-hammer*; all these are fastened to the handles by straps and rivets. Carpenters and joiners use hammers of various sizes and weights with short heads, generally with octagonal faces, and at the other end a very blunt sort of chisel crossways. These heads have holes in them, and are fixed to the handles by simply wedging.

A magnetic hammer for the use of upholsterers has been in-

vented, which, being magnetized, has only to be advanced to a tack lying loose, to cause the head (being the bulkiest part) of the latter to instantly adhere to it so as to be ready for driving. J. W.

HAMMER BEAM ROOF. A name given to one of the latest forms of construction of Gothic roofs, and possibly derived from the French heraldic term *hamade*, signifying three pieces framed or riveted together in a triangular form; this would actually be what is called the hammer beam truss, formed by the wall piece, the curved brace, and the hammer beam itself, Fig. 1. The hammer beam which has given the name to roofs of this class is, in fact, an ingenious means of reducing the width to be roofed over; for if properly constructed the span is reduced, so to say, to the space between the inner ends of the hammer beams, so that a simple braced roof of the accompanying form, Fig. 2, may be converted

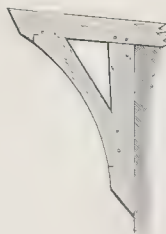


Fig. 1. Hammer Beam Truss.

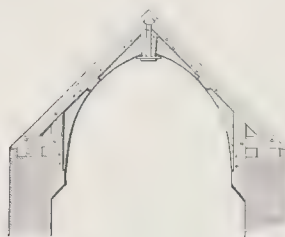


Fig. 2. Simple Braced Roof.

into a hammer beam roof to cover a larger span, by lengthening the principal rafters, the wall pieces in the former roof become struts in the second, tenoned into the inner ends of the hammer beams, while other wall pieces are framed into the underside of the hammer beam, and these are connected together by means of curved braces, so that the framing, which in the first instance would only span a building 15 ft. wide, would by being converted into a hammer beam roof cover a span of from 20 to 25 ft., or even more, according to the length of the hammer beams, Fig. 3, which

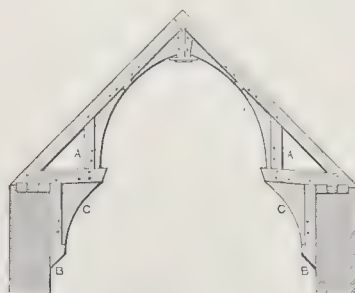


Fig. 3. Single Hammer Beam Roof.

varies greatly in different examples. They are to be met with as short as one-eighth of the span, as in the roof over the nave of Capel S. Mary's church, Suffolk, and as long as one-quarter, as in the roof over the nave of Trunch church, Norfolk: between a fifth and a sixth appears to be the best proportion for a single hammer beam roof.

Before hammer beams were introduced, the lower end of the rafter, B, Fig. 4, was formed into a triangular foot by means of a strut, A, sometimes called an 'ashlar rafter', and what has been called a wall beam, C, about as long as the thickness of the wall, so as to give it a good seat on the double wall plates, D, on to which it was halved. In the roofs under consideration, the hammer beam takes the place of the wall beam,

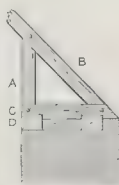


Fig. 4. Ashlar Rafter.

is halved on the plates, and projects a considerable distance into the building, and the triangular foot for the lower end of the principal is formed by means of a strut, A, Fig. 3, framed into the underside of the principal, and on the inner end of the hammer beam. The outer end of the beam rests upon the wall and just on the inside of the wall a timber called a wall piece, B, somewhat longer than the hammer beam, is framed into the underside thereof, and hangs down against the wall, resting sometimes, though not necessarily, upon a stone corbel, and the weight on the inner end of the hammer beam is brought down to the bottom of this wall piece by means of the curved brace, C. Sometimes, when the span to be covered was considerable, double ranges of hammer beams were used; the construction, however, is precisely the same, the upper ones serving to stiffen the principal rafters, and at the same time to bring the weight down on to the ends of the hammer beam and thence to the walls.

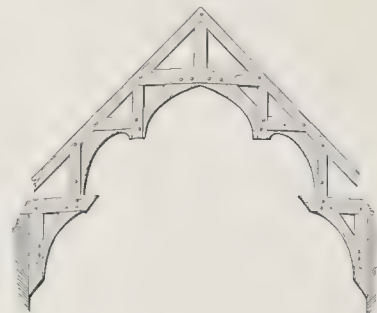


Fig. 5. Double Hammer Beam Roof.

These roofs are susceptible of, and usually receive, a great amount of ornamentation. The king posts are sometimes beautifully wrought into figures of angels with outspread wings; and others, also with expanded wings, were placed at the feet of the wall pieces and the ends of the hammer beams. The lower ends of the wall pieces were sometimes worked into niches filled with figures of saints, over whose heads were suspended elaborately carved canopies. The rafters, purlins, cornices and other timbers were always richly molded and carved, and the effect of these roofs was greatly heightened by bright colours and gilding.

In roofs for buildings of this last period, of larger space than the ordinary naves of churches, and especially for secular pur-

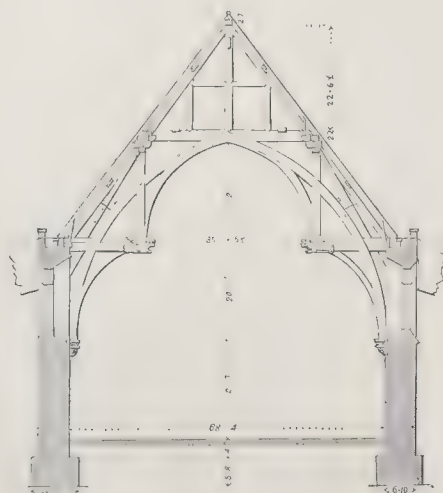


Fig. 6. Westminster Hall.

poses, while the hammer beams were still retained, another important structural feature was introduced in the shape of a large arched piece of timber springing from the bottom of the wall piece, framed through the hammer beam and strut, and meeting in the centre of the collar beam, which was in these cases usually placed much lower down in the roof than in those already described. Such are the roofs of many of the halls in this country, as at Eltham, and at Hampton Court; while that at Westminster, dating 1395-99, may fairly be cited as unique in the world for its size and beauty; its clear span is 68 ft.; its total length, nearly 239 ft., is divided into twelve bays. Fig. 6 illustrates its general construction. VIOLLET LE DUC, *Dict.*, s. v. Charpente, remarks of this roof "à la fin du xiv^e siècle et au commencement du xv^e, l'Angleterre était victorieuse, riche et florissante; la France, au contraire, était ruinée par des invasions désastreuses et les querelles des grands de la couronne; aussi n'avons nous rien à cette époque, qui puisse être comparé à la grand'salle de l'abbaye de Westminster comme luxe de construction."

R. B.

The ARCHÆOLOGIA, 1836, xxvi, 417-8, gives the details of the discoveries in one of the restorations of this Hall; in the concluding remarks by S. Smirke, R.A., he observes that "A brace of very great strength has been made in every truss to relieve the principal rafter, by catching it at about two-fifths of its height upwards, and carrying down the pressure nearly ten feet below the foot of that rafter; this important timber, bulky in its scantling (for at the lower part it is no less than 18 ins. by 12 ins.), and essential, I imagine, to the stability of the roof, has eluded general observation, for, except in Pugin's engraving of this roof, in the first volume of his *Specimens*, etc. (1820), it has been inserted in no published representation of the roof that I have examined." After remarking that the arch does not carry the roof, and the uselessness of the corbels, Mr. Smirke adds, "this roof is the common collar beam roof, and of extremely simple construction: the whole pressure is carried, by the straight lines of the principal rafter and brace above alluded to, directly into the solid wall, where it ought to be";—Fig. 6 is reduced from the sections of the Hall, and of a bay, drawn by George Allen 6 February 1836, and published by Weale in that year; this shows the above named brace; as does the perspective view in BRAXLEY, *Palace of Westminster*, 8vo., London, 1837. Various markings on the arch rib as drawn by PUGIN show that it is made of various thicknesses, and a true section of which is wanting.

Fig. 7 is a simple form of hammer beam used in the old roof of the parish church of Kirk Fenton in Yorkshire, restored by G. F. Jones, 1844; A, principal rafter; B, hammer beam; C, dove-tail notch for wall plate or stone; D, wall piece; and E, the curved brace.

The hammer beam mode of forming a truss, was executed as early as cir. 1350 in the roof of the Trinity church at Ely, 46 ft. wide, WARE, *Arches*, 8vo., London, 1809, pl. 8. The hammer beam was probably first used in roofs where the construction depended on the curved braces, and struts or some other pieces were required to keep them from springing. The pitch of Eltham hall roof is 49°; that of Westminster hall, 53°, the steepest of several that have been ascertained. The derivation and origin of the term are very doubtful; the earliest use of it is probably by NICHOLSON, *Dict.* s. v., edit. 1819; then in STUART, *Dict.*, cir. 1831; and BRITTON, *Dict.*, 1838. Early descriptions of these roofs do not contain the

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word; for at least up to 1828, the straight piece is called 'beam' or 'girder'; and 'bracket' is applied to the triangle: VIOLLET LE DUC does not use a corresponding French term for the hammer beam: it has been suggested that it is so called from its resemblance to the head of a hammer, the wall piece representing the handle. Besides the books mentioned s. v. CRADLE ROOF, a good notice of such roofs is given in THE BRITISH CRITIC, etc., 8vo., Lond., 1841, xxix, No. 58, 441-89; and 1842, No. 62, xxxi, 452-77. MORRIS, in *Transactions of Royal Institute of British Architects*, 24 June 1850, given in CIVIL ENGINEER Journal, xiii, 249; and ARCHITECT Journal, ii, 345.

A roof of the period, over the hall of the palace of Henry VII at Richmond, was described as "of tymbre, not beamed, nor braced, but proper knots crafty curved, joined and shut together with mortises and pinned, hanging pendent from the side roof on to the ground and floor, after the most new invencion and craft of the prospectif of Gement": the correct reading of these last words is given s. v. GEMENT.

HAMMER BLOCKING, see GRANITE, p. 74.

HAMMER-DRESSED WORK. This term seems to describes four, if not five, results. One is attained when a piece of freestone, rough as taken from the rock (when it is called a penny-stone, quarry-lump, or rough-stone) is scapled or coarsely shaped with a heavy hammer. Another is produced by more carefully scapling the face of the stone, as for some sorts of rusticated work where portions project considerably before the joints. Another is obtained by reducing that projection, and a face carefully scapled is sometimes described as hammer-dressed ashlar. Another is seen when a stone is draughted round the edges but has the rest of the face roughly worked with the hammer, and becomes a scapled and draughted ashlar. Another is when granite is squared and faced smooth by means of any of the hammers above named having a sharp pen or point; and then the work is often called nighed or nigged ashlar, or else ashlar smooth and fine hammer-dressed on the face. FACE WORK.

HAMMERER (JOHANN or HANS), stonemason (steinmetz), one of the foremen (werkmeister), succeeded J. Dotzinger as architect at the cathedral of Strasburg. He designed 1485-6 the beautiful kanzel or pulpit of stone, with about forty figures around it; the canopy having been damaged, it was replaced 1617 by a new one of wood by Conrad Cullen and his son, but in bad taste; the description and view of it are given in the scarce work by SCHADEUS, *Beschreibung des Münsters zu Strasburg*, 4to., Stras., 1617, 32, 83. In 1486 he was sent to Milan as adviser; and in 1489 he built an arched chamber near the chapel of S. Catherine for the records of Strasburg cathedral. He succeeded J. Dotzinger as grand master of the lodges of masons in Germany; GRANDIDIER, *Essais historiques*, etc., sur l'église, 8vo., Stras., 1782, 423. 68. 92.

RAMÉE says he succeeded Jacob von Landshut, and directed the works 1510-20 which, though so late, show no traces of the Renaissance style. 112.

HAMMITE. A fine-grained oolite; see AMMITE.

HAMPALEDE. A rather soft, fine, though open-grained, heavy wood of Ceylon. 71.

HAMPTON (JOHN), "an attendant upon the king's person", is mentioned as the surveyor (? overseer) on behalf of king Henry VI at the commencement of the building of Eton college, Berkshire. His accounts commenced Monday 3 July 1441, and end June 9 "anno tertio edificationis". Wm. Lynde was clerk of the works. In 1451 the House of Commons petitioned the king to remove John Hampton with others from his royal presence. GUTHRIE, *Hist. of England*, fol., London, 1747, ii, 607; BRITTON, *Antiq.*, 4to., London, 1809, ii, 89.

HANA, HANE, and HAEN (NICHOLAS DE), a master mason of Scotland who 1377 was paid for making "the tomb of our king" (Robert II, if taken as the reigning monarch, or David II, if the late king, who died 1371): 1379 he received £120

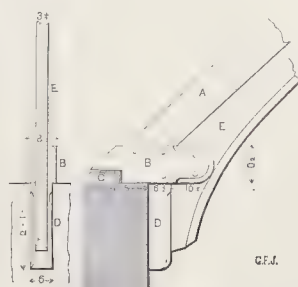


Fig. 7. Hammer Beam.

partly for his salary; 1394, a sum for "a stone of a tomb taken from the church of S. John of 'pth' (Perth?) for the sepulchre of the late king Robert II (died 1390), and for the carriage of it to Scone, 4s."; and in 1398-1402 he is also called the king's "claviger", and received £10 per annum from the great customs of the borough of Dundee. In 1438 "magister Nicholao carpetario" occurs, but probably not referring to the same person; BANNATYNE CLUB, *Accounts of the Great Chamberlain*, 1326-1453, 4to., Edinburgh, 1817, ii, 93, 102, 230, 418, 473-4, 490, 545; iii, 382.

HANCE, HANSE, or HAUNCH, see HANSE.

HAND. A measure, which by the statute 33 Henry VIII, c. 5, is declared to be 4 ins. in breadth.

HAND ARCH. The term given to a small arch turned by the hands of the workman, that is, without centring, where it may be desirable to form an opening or recess in the wall.

HAND BARROW. A frame of wood, the prolonged and rounded sides of which form four handles, and to which short legs are sometimes attached. It is used by masons for the removal of delicate work, and by gardeners for the transport of large pots or tubs of trees in blossom or in fruit: it is known as a "block horse" in the eastern counties of England. Gardeners also use two other forms of hand barrow; one is the "flowerpot barrow", being similar to the above, but having one or two rails round it above the handles, so as to prevent baskets, etc., from slipping; the other is the "haulm barrow" without a wheel, being merely an open box or case of wicker or other work placed on, or suspended from, a pair of handles, for carrying litter.

In Scotland, a framed and boarded hand barrow is much used by masons for carrying heavy stones up to the necessary height, by means of the sloping inside gangways there used in building; three men to each end being frequently required. J. W.

HAND BRACE, see BRACE.

HAND FLOAT. A wooden trowel used by plasterers for finishing rough stucco, cement, and other plastering, when the grain of the sand is to be left on the surface. FLOAT. A. A.

HANDICRAFTSMAN. One who practises the mechanical process of any manufacture in which hand work is required. By the 2 and 3 Edward VI (1548-9), c. xv, s. 4, such persons were allowed to work in towns where they were not free; but this act was repealed in the following year. Such acts were superseded by the well known statute of 5 Elizabeth, 1562-3, which continued in force until so late as 1813-4, when those portions were repealed which affected the rating of wages, and also the exercise of trades by persons not having served their time, etc. PAPWORTH, *Superintendents*, etc., in *Transactions of the Roy. Inst. of Brit. Architects*, 1861-2, p. 51. WORKMAN.

HAND IRON, see ANDIRON.

HANDLE BLOCK, see BLOCK.

HANDLE OF A DOOR, DRAWER, etc. This was formerly a bow or an oval knob fixed to cut or ornamented plates, but now in almost all cases a round knob, of metal, of ebony or other woods, or of china. KNOB; LOCK. A. A.

A door or drawer handle was of two sorts; viz. the stiff, and the loose, bow: each of these being made with, or without, a plate; e.g. drawers had handles, drop handles, and flush drop handles. For the knob and handle patented 1856 by Heywood and Dixon, a hole is drilled through the front of the door or drawer, and the knob is secured by a wooden screw, the head of which is inside.

HANDLE OF A TOOL (It. *manico*; Sp. *asidero*; Fr. *manche*, *poignée*; Gr. *handhabē*). That part of a tool held in the hand of the workman. The handle of an axe or adze is called the *helve*; that of a jack plane, or a trying plane, the *tote*. Chisels are either *socket* handled or *haft* handled; that is, the tang is merely driven into the wood in the direction of the grain. Bricklayers', plumbers', and common claw-hammers are *strap* handled, there being a long strap of metal on each side of the wood riveted through. Joiners' hammers have handles pass-

ing through a hole in the head, and secured by wedges; mallets are handled much in the same way. Cross-cut saws have upright handles; rippers, hand, and panel saws have peculiar handles, a hole being cut in the piece of wood which is fixed to the metal for the hand to pass through. Tenon, sash, and dovetail saws have similar handles, but open on one side. A. A.

HAND OF BRICKS. In setting kilns, loading carts, barrows, etc., five bricks placed flat on each other are called a "hand". Twelve hands, or sixty bricks, is a crowding-barrow load. A. A.

HAND PICK. A slater's tool.

HAND RAIL (It. *branca di scala*; Sp. *pasamano*; Fr. *tablette*; Ger. *geländerstange*). The rail or capping to any balustrade, but generally applied to the wooden railing of a staircase. Formerly the hand rail was formed of straight pieces, seldom less than 4 ins. by 3 ins., with a flat molded back (or upper surface) finishing with knees, and mitring round the top of large square newels. The introduction of geometrical staircases, and the frequent use of winders, necessitated what is called a *continued* rail, or one following the curve of the outer string, and gave rise to a branch of joinery involving great skill both in setting out and execution. There are either *solid* rails, or those *glued up in thickness*; the latter have been described *s.v.*, and *s.v.* CYLINDER. The various parts of a hand rail are the *scroll* or *newel cap* at bottom; the *rake* or straight rising rail; the *ramp* or swan-neck, where the rail finishes on a newel with a sort of *S* curve; the *level circular*, when round a curved landing; and the *wreath*, when it is curved both in plan and section. The chief art is in the construction of the latter.

The first thing is to get out the *FALLING MOLD*; and thence the *FACE MOLD*. These are developed from plan and section by ordinates. Formerly the face mold was applied to the plank of mahogany or other wood and scribed thereon, and the various pieces of the rail sawn out, by cutting through the same at right angles to the surface in the usual way, or by what is called the "plumb cut". Directions for the performance of all this are given in PRICE, *British Carpenter*, 4to., London, 1733. Of course, if the wreath or curve was quick, a plank of considerable thickness was required, and the consequence was a great waste of stuff. During the long continental war, when the price of all materials was so very high, particularly of all imported woods, it became an object to save stuff, and get the curved portions out of as thin a plank as possible. A method was invented of cutting through the plank obliquely instead of at right angles, the credit of which is claimed by P. NICHOLSON, in the *Transactions of the Society of Arts*, etc., 8vo., Lond., 1814, xxxii, 121, where he says he first gave it to the world in his *Carpenter's Guide*, 4to., Lond., 1793. This has been called "cutting the plank on the spring", or more shortly "springing the plank", and supposes three points to be found in the curve of the cylinder and the plank laid thereon, or as the author explains it, "supported on the ends of three upright rods." The extra time required in getting the complication of lines, and the chances of spoiling stuff through errors, has been considered by many to counterbalance the advantages of saving stuff, especially as the price of mahogany has fallen so much since the war. Several contrivances have been invented to get out the lines in a simple way; one of which is given in the same *Transactions*, 1826, xlv, 142, and called "Hartley's hand rail sector", which shows a method of transferring points in a circle drawn on a horizontal plane to another which is inclined, but it did not get into general use. In either system, after the pieces have been cut out of the plank by the bow saw, and they have been roughly molded by the gouge, the next thing is to find and work the butt joints, and to put the rail together with joint screws. These are right and left screws with nuts, on which are notches. They are buried in the middle of the ends of each portion of the rail, and the screws tightened by turning the nuts; these holes are afterwards carefully filled up with pieces of the same wood. The pieces thus being accurately fitted together, are molded by

planes made for the purpose, which are sold in sets by the name of "hand-rail planes". The rail being ready, the iron newel and the iron balusters are fixed to the strings, and to them the rail is screwed and then polished.

As it is now the fashion to have much larger handrails than were in use twenty years ago, it has been found cheaper to make the rails of deal or some inferior wood, and to veneer them with various superior woods. Instead of the intricate method of getting the molds out by ordinates, thin flat pieces of lead or zinc are bent on to the curve formed by the nosings of the stairs, and then the rail is roughly got out by applying to them the stuff. When put together by the joint screws, it is then molded and the veneers glued on, and kept in their places till dry by 'cores' in the usual way. The joints of the veneers are best put together in the method shewn in *GLUING UP IN THICKNESS*, but this is now rarely done. In fact, the chief fault of these rails is the jointing. The veneer covers all faults, and it is only when shrinkage takes place that they are discovered. Iron handrails, and iron covered with brass or cloth, or capped with wood, are common where there are iron balusters: they are either of rod or flat iron bent to the curve when hot, and riveted or screwed to the tops of the balusters; and the wood handrail screwed to it. Stone and marble handrails are also common in stone staircases, but these are almost always in straight flights with level quarter spaces; sometimes they are inlaid with other marbles, etc. One in which glass was introduced was put up about 1848 in Devonshire house, Piccadilly.

A. A.

The Fr. *écuyer* is the proper name for a rod of wood or iron held in rings, which serves as a handrail against a wall. A stone handrail round the newel of a vice or circular staircase, is to be seen at Canterbury cathedral, and at S. Alban's abbey. In Paisley abbey is an example, sunk flush in the circumferent wall of a circular turret staircase; and at Eton college, in one or two cases the handrail is cut into the wall with good effect.

MOORE, *Joiner's Geometrical Tutor for Stairs, Handrails, etc.*, 4to., Hull, 1851; GALPIN, *Joiner's Instructor*, etc., 4to., 1853; RIDDELL, *Staircasing, Handrailing, etc.*, 4to., London, 1860; and *Handrailing Simplified*, etc., fol., Phil., 1856; BANKS, *Staircasing and Handrailing*, 8vo., 1849; JEAYS, *Orthogonal System of Handrailing*, etc., 4to., 1850 (rewarded by the Society of Arts, etc.); and reviewed, with woodcuts, in the *BUILDER Journal*, viii, 459; ASHPITEL, *Handrails and Staircases*; a new and simple method of finding the lines, 4to., 1851; NORMAND, *Recueil d'escaliers en pierre*, fol.; NICHOLSON, *Construction of Staircases and Handrails*, 4to., London, 1820; EMY, *Traité de la Charpenterie*, 8vo., Liège, 1842, ii, cap. 35; and NEWLAND, *Carpenter and Joiner's Assist.*, fol., London, 1860.

HAND SAW, see Saw.

HAND SPIKE. A wooden lever for moving heavy articles; or turning a capstan, windlass, etc.

4.

HANENBERCH (AMBROSIUS VAN), from Bois-le-Duc, was appointed town architect with H. P. Dierex in 1526. It is probable that the immense cellar made under the town-hall in 1529, and the gate called S. Janspoort 1532, were designed by them; OUDENHOVEN, *Hist. of Bois-le-Duc*.

24.

HANG CHOO, HANG-CHOW-FOO, or HANG-TCHEOU-FU. The capital of the province of Che-Keang, and one of the most important and richest cities in China. It is situated near the Se-hoo, a small lake the banks of which are crowded with temples, and at the southern terminus of the imperial canal, and about two miles from the river Tsien-tang-Keang, which at that part is about four miles wide. The high and well built walls are about eight (some writers say fifteen) miles in circuit, and include many large vacant areas, with spaces for the garrison of 7,000 troops; for the courts and troops of the governor-general of Che-keang and Fo-kian; as well as for those of the governor of the province. The streets are narrow, as usual in

China, well paved, and clean; the houses of one story; with numerous triumphal arches, monuments to great men, and gorgeous Buddhist temples: the city is intersected by several canals.

50. 72.

HANGING, see SASH; SHUTTER, etc.

HANGING BRIDGE. A term sometimes applied to large covered bridges as those in Switzerland. It has also been applied to the large tubular bridges lately erected in England.

HANGING BUTTRESS. The semi-hexagonal or triangular fronts of canopies to niches have usually hanging buttresses and "corses", which are terminated below with knots of foliage or other bossy sculpture. These are the 'botrac' faux p'r le plus bas degre; namely, buttresses with a false bearing, a term always applied in French to architectural members which do not stand fairly and directly upon a foundation; WILLIS, *Arch. Nom.*, 4to., Camb., 1844, p. 76. BUTTRESS.

HANGING LEVEL. The term applied to a slope of the ground on which a building is erected. In some situations the difference of level at the wings of a building is considerable, and great ingenuity is required if the materials of the composition are necessarily, like columns, uniform in height: one of the most familiar instances of the successful treatment of such work is afforded by the colonnade at the opera house towards the Haymarket in London. In the street of the silversmiths at Pompeii, which sloped with a very gentle descent away from the forum, the courses of masonry and the moldings, instead of being laid horizontal, ran parallel to the slope of the ground, so as to avoid the necessity for making the lines of the architrave horizontal, and thus the uniformity of the street was ensured.

Garden and other boundary walls of brick, when inclined longitudinally, are frequently built with the courses inclined, to avoid the cutting of the upper courses, which is necessary where the coping is not to be stepped.

J. W.

The term is most commonly applied to eaves gutters, which have to be fixed at a slight slope to give a fall for the water.

HANGING OVER. The opposite of "battering". The condition of a wall when a plumb line from the top would touch the ground at a distance from the bottom. Such is so frequently the state of a wall, that it seems desirable to mention that this may arise from causes other than the one which usually offers itself, viz. the thrust at the top from the roof: an equal effect is produced by the rottenness of the piled or planked foundation: and DE LASSAULX, *Remarks in WHEWELL, Arch. Notes*, 8vo., Cambridge, 1842, p. 176, notices another when, repudiating the idea that the side walls of certain churches hang over in consequence of the thrust of the arches, he adds that the fault may "generally be ascribed to the circumstance, that means are seldom or never provided for allowing the water, which falls from the roof, to flow away—in a dry season every soil becomes more or less cracked—the water flows into this crack and soaks into the foundation of the walls—the wall of course sinks by its own pressure, and the sinking of an inch in this place causes the top of a wall 12 ft. high to fall full a foot out of the perpendicular." This author might also have noticed the extraordinary movement of a foundation which is not laid deep, in a clay soil, and the possibility, which takes place when very dry weather commences, that buttresses may sometimes pull a wall, should also not be forgotten. The means adopted in various cases for restoring walls to their perpendicular have not been much examined: among them are those used at the transept of Beverley minster, by N. Hawkmore and Thornton, the carpenter; at the west front of Croyland abbey, by G. G. Scott; at the south transept of Rochester cathedral, by L. N. Cottingham; also the "saw curfing", on the opposite side, of the joints of brickwork in tall factory chimneys.

One mode adopted has consisted in inserting through the walls, across the building, a series of tie-rods having screwed ends, nuts, and broad washers, tightening these up, heating

F

by means of lamps or chafres every second rod in the series, causing them to obtrude, screwing them up tight again while hot, then doing the same to the other alternate rods; thus making the contracting force of the cooling rods available for drawing the walls, step by step, towards each other. The sides of many churches have been caused to overhang by the digging off graves.

J. W.

HANGING RAIL. The rail at top or bottom of a door or window, according to the place where the hinges are fixed.

HANGINGS. It is possible that Attalus, king of Pergamus, had cashmere shawls for hangings and curtains; it is certain that, from the time of the inheritance of his treasures by the Roman people, the use of hangings was in fashion in Italy; *AULEA*. DONALDSON, *Archit. Numismatica*, 8vo., London, 1859, p. 24, notes the curtains and hangings used in the temples of the Greeks.

It is hardly possible to doubt that till the decline of Byzantine art the manufacture of embroidered cloths, if not of stuffs with pictorial or ornamental designs, was continued for the purpose, perhaps in the gynæceums; and it has been noticed *s. v.* ARRAS HANGINGS that such woven stuffs have been made in France at least since the middle of the ninth century. But the middle ages possessed a great variety of materials to be used as hangings: not only does *HALL*, *Union*, fol., London, 1548, in one phrase mention (1501) rich arras, costly tapestry, fine cloths both of gold and silver, curious velvets, beautiful satins and pleasant silks (which is sufficient to establish the fact that arras and tapestry were not always identical), but we hear of baudekyn (silk and gold); camlet; crape; flowered damasks; cloth of embroidery (for chairs); fustians; kersey lined with southege (perhaps serge); matting; sarcenet (1460-80); say or shag (silk and wool); Tartar hangings; striped Turkey say (1510-50); work of the Turkey making (for cushions); tissue of divers makings; tapestry of silk and silver in pictures for hangings, coverlets, and carpets; cloth of wool woven with portraits; and tapits of red worsted (1466); all more or less used for hangings, and superseded by other materials.

The oldest existing piece of work for hangings may be that preserved at Bayeux in Normandy, which is tapestry, *i. e.* canvas covered with needlework: in 1375-1400 worsted stuffs for arras were made at Norwich, whence it is evident that arras had become a generic name for a hanging; in 1392 woven tapestry was made in London, whence it is evident that *tapestry* was not restricted to canvas with needlework; in 1441 cloth of arras was still imported into England; in 1475-1500 stamped leather was as fashionable as wainscoting; and in 1503 mention is made of counterfeit arras, which was probably the "goodly hangings of fine painted cloth" executed by More in his youth, and seems to have been canvas well primed and painted in distemper (though *NARES*, *Gloss.*, 4to., London, 1822, says in oil), yet it is impossible to conceive the use of such materials for the "counterfeit carpets" mentioned 1510-50 as substitutes for English and Turkey carpets for tables at a time (1548) when such carpets were made of silk bordered with velvet or of embroidered cloths. It would not perhaps be erroneous to suppose that the early carpet-weaving and the *haute* and *basse lisse* of the French and Flemish looms were very much the same thing, if not identical; for such carpets might cease to be made with pictorial subjects for hangings, and yet be arras no longer used for hangings, but laid upon the floor. Hangings of embossed leather (a treatment familiar to the Egyptians) seem to have been revived in the Middle ages, and to have been extensively used during the sixteenth and seventeenth centuries in Flanders and France, whence they were imported into this country. The mode of manufacture was to join the skins; to silver the whole surface, using coloured varnish to give the effect of gold; and to stamp the work by cut wood blocks in a press, finishing delicate work with tools such as those used by bookbinders: in Paris plaster blocks are now employed, and much flock is added to the face of the work; *CIVIL ENGINEER*

Journal, 1848, xi, 61. Hangings of the above materials seem to have been fixed either loose on pegs about 8 or 10 ft. high from the floor (*BUCKLER*, *Magdalen College*, 8vo., London, 1823, p. 85, mentions the ruined hall of Sudeley castle, and the prior's hall at Wenlock, as two instances where the tapestry pegs remained), or else on projecting frames by tenterhooks, in both cases being movable by the upholder and his yeomen-hangers; or in some cases (especially as such stained hangings 28 ft. long and 7 ft. 6 ins. high) on straining frames like pictures, otherwise the work would crack and peel off; *DALLAWAY*. A suite of hangings for a chapel and for a hall seems to have been described as a chapel, and a *salle*, or a *hallyng*.

From about 1700 the use of paper hangings became at first fashionable, then usual, and is now so common that for more than fifty years the decorators of the best apartments in palaces have resorted to the use of velvets, satins, silks, and cloth, strained tightly on battening for permanent wear; and of other less valuable materials, as chintz and calico, for temporary purposes, or to be soon renewed.

A patent to be the royal arras maker was granted to John Mustian by Henry VIII; in whose reign Robert Hicks, who had the use of Mr. W. Sheldon's manor house at Barcheston in Warwickshire, is called in the will (dated 1570) of Mr. Sheldon "the only auter and beginner of tapistry and arras within this realme"; *LYSONS*. Fragments of the tapestry there made were to be seen at Strawberry Hill.

Whether this distinction of tapestry and arras be not that of *haute* and *basse lisse* is a subject too full of matter for discussion here: it is enough to add that in the reign of James I. a factory was established about 1619 at Mortlake by Sir Francis Crane, which was ruined in the civil wars, *MACPHERSON*, *Annals of Commerce*, 4to., London, 1805, ii, 296; and that the authors of the *Encyclopédie* state plainly that the English pushed the fabrication to such an excellence that they deserved to be termed at least the restorers, if not the inventors, of the manufacture; yet this compliment seems to be weakened by the general understanding that the arras-weaver to the king, 1759, was the last maker of that fabric (whatever it might have been) in England.

HANGING STILE (*Fr.* *chardonnet*). That stile to which the hinges are fixed by which a door or sash is hung. Good joiners always take care to frame doors so that the heart of the stuff should be to the outside, as it affords better hold for the screws than the sap, and the doors are not so liable to wind.

A. A.

HANHAM, in the Bristol coal field, supplies a light grey coloured micaceous gritstone much used for paving. *PENNANT STONE*.

HANNOVER or **HANOVER** (*Lat.* *Hanovera*; *Fr.* *Hanovre*). A city, the capital of the kingdom of the same name, in Germany. It is built in an extensive plain on the banks of the river Leine, which receives the waters of the Ihme, and then becomes navigable to the Weser; dividing the city into the old and the new town, which are connected by eleven bridges; the former, on the right bank, is ill built and dirty; the latter contains a fine square called *Waterlooplatz*, several spacious streets, and some handsome public and private buildings. The old gable houses, hereafter referred to, are highly picturesque. The city is entered by five gates; the streets are well paved, but, with a few exceptions, not very wide; gas has been introduced since 1826. The Leibnitz monument, erected in 1787-90 after a design by Hofrath Ramberg, is situated at the end of an avenue of linden trees above a mile in length; it is a temple 31 ft. 8 ins. diameter, of twelve columns of the Ionic order, each 2 ft. 2½ ins. diameter and 20 ft. high, of a hard grey stone quarried in the Hartz mountains, supporting a cupola 38 ft. 10 ins. high above the steps, beneath which is placed a white marble bust, and bears only the simple inscription "Genio Leibnitzii"; it cost 5,000 thalers. The Waterloo

monument, 162 ft. high, having a winding staircase within it, and surmounted by a statue of Victory, was designed 1826-32 by Laves; it is situated in the *place* of the same name, and is dedicated to the memory of the Hanoverians, officers and privates, who fell in the battle.

The most prominent of the public structures are: the *marktkirche*, dedicated to S. Jakob and S. Georg, built 1349-58, is a plain structure of three aisles equal in height, and the choirs finished each with half a decagon; the exterior is still unfinished; a metal plate now in the sacristy records the commencement 1350 of the tower, 306 ft. in height, and which is terminated by a colossal circle, a pentagon, and a sextant on each of the three pinnacles; the inside is also noted for its display of masonic emblems; the bold circular pillars, and high cross-vaultings; the painted glass windows of the fourteenth century; a Gothic metal font of good workmanship; and the head of S. John the Baptist on a plate, carved in wood, are the most noticeable objects therein: the *schloss* chapel, formerly the church of the Minorites, built 1642, contains an altar-piece by Lucas Cranach; this building is known best for the vaults in which king George I. of England and his mother, the granddaughter of James I., are buried: the *kreuz* or cross church, built 1333: the *Ægidien*, or S. Giles's church, built by Meister Wittemeyger 1347 (LANGE states the old church was pulled down 1397, as recorded on one of the outside pillars); the old tower was pulled down 1701, and the present one finished 1717; the church was restored and remodelled 1825-7: the *residenz schloss* or royal palace, 1636, of which the chapel and some other parts remain; in late years it has been considerably enlarged, and contains several valuable collections: the *Fürst-enhof*, or residence of the prince royal: the palace of the duke of Cambridge, in front of the *schloss*, built 1752: the *landschaftlichehaus*, where the estates of the kingdom meet: the *rathhaus* or town-hall, dating 1455, a curious specimen of brickwork, ornamented with coats of arms and full-length figures in terra cotta: the royal library of 40,000 volumes: the opera house: the new theatre, 1851, said to be one of the most striking modern buildings in Germany: and the royal stables. The royal château of Herrenhausen, a low building of no merit but that of preserving some royal portraits connected with England, is situated near the city; in the grounds is a grand *jet d'eau*, rising to the same height as that of S. Cloud (120 ft.), but with a body of water far more voluminous. The château of Montbrillant is also much praised by the citizens of Hanover.

MITHOFF, *Archiv für Niedersachsens kunst Geschichte*, fol., Han., 1853, gives the following illustrations in the twenty-four plates:—Pl. i-v, the portal of the tower; a view, ground plan, section, and interior; with details of the altar, of the *Marktkirche*: pl. v, vii, ix, ground plan, view, and font with details, of the *Ægidien-kirche*: pl. vi, viii, the altar piece, font with details, in the *Kreuz-kirche*: pl. xxi-xxiv, views of the *rathhaus*, with details of terra cotta; pl. xvii, terra cotta friezes of the Leibnitz house, No. 10, *Schmiede-strasse*, and many others; pl. xi-xx, wood ornaments of several houses; details of No. 29, *Schmiede-strasse*; of Nos. 37 and 48, *Markt-strasse*; No. 28, *Knockenauer-strasse*; No. 14, *Schmiede-strasse*; No. 33, *Burg-strasse*; the old chancery near the *Ægidien-kirche*; and No. 28, *Köbelinger-strasse* (1501); which last is also given in GAILHABAUD, *L'Architecture*, 4to., Paris, 1852, iii. MÖLLER, *Denkmäler*, fol., Leipzig, 1821, pl. 49-51, also gives three of these old houses of rubbed brickwork. A brick barn, 1856, 75 ft. long and 36 ft. wide, by Haarmann, is given in NOUVELLES ANNALES de la Construction, fol., Paris, 1856, ii, pl. 36. LANGE, *Original Ansichten—von Deutschland*, 4to., Darmstadt, 1843, iv, gives several views. PENTHER, *Lez. Archit.*, fol., Augsburg, 1775, gives the *Landschaftshaus*, pl. 39-43, and the *schloss Opernhaus*, by J. F. Junge, pl. 78; *ENCYCLOPÆDIA BRITANNICA*, xi, 139; HODGSKIN, *North of Germany*, 8vo., Edinburgh, 1820; WILSON, *Travels through Russia*, etc., 8vo.,

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London, 1825; BATTY, *Hanoverian, etc., Scenery*, fol., 1829. The ALLGEMEINE BAUZEITUNG, 1851, gives in pl. 400-428, all the stations, sheds, engine houses, and other buildings on the Hanover and Brunswick railway, designed by A. Funk, inspector of buildings, and L. Debo, *conducteur* or resident engineer. 114. 115.

HANS (MEISTER), was *baumeister* to the churches at Halle (1427-92), Salzburg, Neu-Oetting (1410-80), S. Jacobskirche at Straubing (1429-1512), and the fine church of S. Martin at Landshut (1407-61), as proved by the inscription on the gravestone to his memory in its churchyard, as follows: "Anno Domini 1432 starb Hans Steinmetz in die Laurentii, Meister der Kirche, und zu Hall, und zu Salzburg, und zu Oetting, und zu Straubing, und zu Landshut. Dem Gott gnädig sey. Amen"; to which the S. Jacobskirche at Wasserburg 1410, is added by KUGLER, *Geschichte*, 8vo., Stuttgart, 1859, iii, 341. 68. 92.

HANS (MEISTER), a stonemason (*steinmetz*) of Mingolzheim, a sculptor and *baumeister*, was practising in 1451, and as late as 1494, if it be presumed that this article refers to the same person. JÄGER, *Kunstgeschichte des Mittelalters aus den Neckar Gegenden*, given in the KUNSTBLATT for 1829, No. 21, quotes a notice found in the archives of Wimpfen, from which it appears that "off Sontag ante Cathar. anno 1451" an agreement was entered into with Meister Hans Steinmetz, for the purpose of constructing a tabernacle for the cathedral church. He was to receive 10 gulden for this work, which was required to be done in a showy, elegant, and useful manner. He was also directed to construct a window, for which he was to receive 11 gulden, on the condition that he would also paint the choir white. The tabernacle as well as this window are still in existence. From a report published in the *Transactions* of the Leipzig German Society, 1829, p. 29, it appears that this Hans superintended the building of the church at Lauffen on the Neckar; and that he was also actively employed on the building of the choir of the church of S. Kilian at Heilbronn (completed by B. Engelberger about 1480-92). This latter fact is corroborated by the ancient statutes of the Strassburg *Hütte* or Lodge of Masons, reprinted in HELDMANN, *Älteste Denkmäler der Deutschen Frei-Maurer Bruderschaft*, Aarau, 1819; in the register it is declared that "Meister Hans von Wimpolzheim, Meister des Buwes zu Heylprun hat dies Buch globt zu Speyer, 1464." As Hans thus swore in 1464 to the statutes of the corporation, it seems rather surprising that he should be admitted so late to the lodge, as in 1451 he was designated a *meister*. On the other hand, when it is considered that the names Mingolzheim and Wimpolzheim may be no typographical error, but two distinct places (which the German biographer has not noticed), it may be supposed that the sculptor of the tabernacle at Wimpfen (Hans of Mingolzheim), and the *baumeister* of the churches at Lauffen and Heilbronn (Hans of Wimpolzheim), are two different artists; which supposition is considered by one author as more probable by the difficulty of admitting that the same artist who was at work already in 1451, was still at work in 1494. 68. 92.

HANS (MEISTER) of Ingelheim, appears in 1480-91 as *werkmeister* for the continuation of the cathedral tower at Frankfurt-on-the-Main. His name is said to be affixed to a drawing still preserved in the archives of the city, but not given on that published by MÖLLER, *Denkmäler*, fol., Leipzig, 1821, pl. 59. He was engaged formally and under an oath by the city council for the work, and on 7 March 1483 the agreement was renewed for the following five years. His fee was 10 florins per annum, but when engaged in other work he was to receive 5s. in summer and 4s. in winter per diem. Under his directions the old and ruined crane (*kranen*) was rebuilt; and many parts of the tower, originally badly constructed or then decayed, were repaired. He conducted the works till 1490, and completed the greater part of the octagon when, the funds becoming exhausted, the works proceeded but slowly. The following year he resigned, in order to save himself from

any blame. PASSAVANT, *Kunstreise*, 8vo., Frankfurt, 1833, 440, gives further details of this construction. 68.

HANS VON GRAETZ, see GRAETZ; and MILAN.

HANS (MEISTER) of Sulzdorf, was in 1427 (1457 with C. Hoeflich) the first *baumeister* of the church of S. George at Nördlingen; BEYSLAG, *Geschichte der Stadt Nördlingen*, 8vo., Nördl., 1798-1801. 92. 116.

HANS (MEISTER) of Ulm, was *baumeister* 1427-35 of the church of S. George at Nördlingen, with Hans Felber. HEINZELMANN. 92.

HANS (MEISTER) of Ulm, built 1516 the church at Kornwestheim near Ludwigsburg. 92.

HANSE or HANCE. A term vulgarly given to each of the two ends of an ellipse, the two sides being each called the 'scheme'; MANDEY, *Measuring*, 8vo., London, 1717, p. 21, who, p. 26, says the term is derived from "hanus, a great bellied thing". An arch which springs with a bold haunch was often called a "hansed arch". Thus it is applied to the four-centred Tudor arch by LANGLEY, *London Prices*, 8vo., London, 1750, 219, the two-centred arch being called "ox-eyed". HIGINS, in JUNIUS, *Nomenclature*, 8vo., London, 1582, 213, says "supercilium; quod ipsis ostiorum antepagmentis, sub ipso superliminari imponitur, the hanse of a door"; and describes *antepagmenta* as the door posts; and *hyperthyrum* as the lintel or transom. This arch is probably the same as the *anse de panier* of the French, and the term may have been derived from it. WILLIS, *Nomenclature*, 4to., Cambridge, 1844, 60, seems in error in considering 'haunse' in HALL, *Chronicles*, Rep. 723, as "the spandril which we now call the haunch." 17.

HANSEN (CHRISTIAN FRIEDRICH), was born 1754 in Copenhagen. Having studied at the academy in that city, he went to Italy, where, from the study of ancient and modern art, and from his predilection for the works of the sixteenth century, he acquired a kind of composite style. On his return to his native country, the English bombardment of the capital gave him an opportunity of constructing many fine buildings at Copenhagen, as well as others at Altona and Hamburg. In 1808 he began the present *Frauenkirche* at Copenhagen, using a great part of the old walls, but giving a new form to the church; WIEBEKING, *Baukunde*, iii, 414, describes this building as one of the most remarkable of modern churches; it contains also the masterworks of Thorwaldsen. Hansen also designed the new town-hall, with a portico with six Ionic columns, and a large court of justice supported by Corinthian columns; the arrangements are considered excellent, although rendered difficult to plan by the irregularity of the site. The castle of Christiansborg, the design of which is attributed to N. Tessin, was restored by Hansen, who constructed in the middle a large saloon supported by six Corinthian pillars; arranged the windows in a better order; and removed the middle part of the back building, substituting a terrace supported by four rows of Doric pillars, communicating with the *bel-étage* of the castle. By this contrivance he opened up a magnificent view towards the sea, hitherto concealed. His new church in the palace, with its portico of four Ionic columns and a cupola, is considered a fine work. Amongst his other buildings are the villas of the brothers Godefroy at Dockenhude near Hamburg; and the castles at Rastdorf and Pardoel in Holstein. Hansen wrote *Samling af forskjellige offentlige og private Bygninger (Sammlung von verschiedenen öffentlichen und Privat-gebäuden)*, fol., Copenhagen, 1825-36, of which fourteen parts have been published; it contains the designs with details of the above buildings. At Athens he designed the university, given in the *BAUZEITUNG*, 1851, p. 374; and 1843-6, with Schaubert, the observatory, given in the same work, 2nd ser., pl. 29; and in *ARCHITECT Journal*, ii, 174. He was professor at the royal academy at Copenhagen; royal oberbaudirektor; councillor; commander of the order of Danebrog; and member of the academies at Copenhagen, Berlin, and Munich. A medal was struck at Copenhagen 24 April 1850 by his friends in honour of the fiftieth anniversary of his

employment under government. The date of his death could not be ascertained. His son (?) H. C. Hansen, has published *Domkirchen Kröbenhavn*, fol. 68.

HAPPE (...) designed 1798 the restoration with court and staircase to the houses of M. Sainte Foix and Carenne, in the rue Basse du Rempart, near the chaussée d'Antin, designed by Brongniart in 1775; KRAFFT, *Plans, etc., Maisons à Paris*, fol., Paris, (1802?), pl. 5-6; and the house of M. de M. Moitte at Mantes; KRAFFT, *Receuil, etc.*, fol., Paris, 1812, pl. 17-8. His death is not recorded.

HAPSE. A catch or bolt of a door or window, but properly the slotted plate which passes over the staple when a pin or a padlock is the fastening. The Ger. *haspe* means such a plate if hinged. 4.

HARAM. An Arabic adjective meaning 'sacred', which perhaps from being applied in the particular case of the temple at Mecca, or rather of the court to that temple, also obtained the sense of excluded, forbidden, or prohibited. Both *haram* and *hareem* (usually written *harem*), when used as a substantive, mean not only the court at Mecca, but any such court, and any sacred place or sanctuary, such as the *harem* i. e. cave of Machpelah at Hebron. Every mosque is situate between two courts; the first of which, placed before the entrance, is called the *harem*; the second, lying behind the mosque, is termed the *rausta* or garden, and serves as the cemetery of the founder and his family: the three quadrangles, court, mosque, and garden, together forming an oblong, are surrounded by a wall, which forms the large exterior court, as in the case of the mosque of Suleiman the Magnificent at Constantinople. The fore-court or *harem* to the finest mosques is surrounded on three sides by dome-covered colonnades, under which is a continuous marble seat placed against the outer walls under the windows; and has in the centre a dome-covered fountain with cypress trees around it, which supplies the water for the prescribed purification before prayer. *Haram* also means the apartments from which men are excluded, in conformity with Oriental habits; and *hareem*, sometimes used to express the whole house, probably means a place that it is unlawful to enter without authority. GYNÆCEIUM. 28.

HARDARY. An Indian measure; see GUJA.

HARDENING TIMBER. The process by which an artificial degree of hardness is communicated to timber for the purpose of enabling it to resist the action of the atmosphere, or the attacks of insects or boring worms. Sometimes the trees are left standing after having been barked; sometimes the wood is exposed to the action of fire, after having been sawn into the required thicknesses; and at other times it is submitted to the mechanical and chemical effects of injections.

1. *Leaving the trees standing after they have been barked.* The first person who called the attention of wood cultivators to this method was DUHAMEL, *Traité de l'exploitation de Bois*, 4to., Paris, 1764, who shewed that the trees that had been stripped of their bark in the early spring, afforded a firmer, harder description of wood in the autumn, when they were cut down; and he attributed the fact to the nourishment, that would otherwise have been employed in the growth of the new wood, being employed in the old trunk. He shewed that the new coat, or the annual ring, was formed under ordinary circumstances between the bark and the wood; and of course this could not take place when the bark was removed. His experiments were not, however, very decided in their results, and unfortunately they do not seem to have been repeated by any subsequent inquirer; but it is probable that his method of felling timber may produce some effect.

2. *The action of fire.* The theory that wood is hardened by the evaporation of moisture from the internal pores seems very questionable; indeed the best authorities upon the subject are agreed that it is not the case, but rather that the hardness is decreased in consequence of the disruption of the fibres to which it gives rise. Still the fact of the great increase in the

durability of the wood that has been subjected to the action of fire, when it is exposed to the effects of alternate dryness and humidity, must be considered to be proved by experience; perhaps the extent to which this process extends is only to the interposition of a coating of charcoal between the ground and the wood desired to be preserved.

3. *The injections.* Advantage has been taken of the powers of circulation in trees, either in place or shortly after being cut down, to impregnate the softer varieties, such as beech, birch, Scotch fir, larch, etc., with a deliquescent salt. The earlier processes have nearly all failed in producing any permanent results; but Boucherie's patent has successfully shewn that the soft woods before mentioned are very advantageously acted upon by a solution of the sulphate of copper, mixed in the proportions of 2½ lbs. of the sulphate to 22 gallons of water; but that the harder woods, such as oak, resisted all attempts to the forcing of the ingredients into them. The former trees were found to admit the injection the more rapidly in proportion as they contained more sap, and were more recently felled. Subsequently, the process of injecting creasote has been extensively used by Bethel and by Burt with remarkable success, as shewn by the experiments published in 1862 by M. Crespin, engineer of the works of Ostend; but in all these cases the injection was either a deliquescent salt, and therefore capable of being removed by the effects of running water; or it was a substance like creasote, that hardly was able to increase the resistance of the wood, though it might add to its durability. Dr. Boucherie tried some experiments by injecting the chloride of calcium, but the results are not given, nor are there any records, by independent authorities, of the results of injecting other substances. BOUCHERIE, *Report*, 8vo., was published by the Permanent Way Company, 1856; the lectures on Kyan's patent by FARADAY in 1836, and by BIRKBECK in 1835: but the theory and practice of injecting timber is, in fact, at present in a very imperfect state. G. R. B.

An ancient practice of hardening timber for ship building was that of keeping it for a long time at the bottom of deep water; it is said to answer the intended purpose. 2.

HARDENING STONE, see PRESERVATION OF STONE.

HARDI (PHILIPPE), son of a sculptor, was born at Toulouse, and studied at Paris, where, on the death 1768 of the queen, he designed a catafalque for the church of S. Etienne of which engravings were made. Soon afterwards he obtained in competition (because his plan had chapels, while Raimond's had none) the commission to build the church of the monastery of La Daurade at Toulouse: the interior only was finished. Although he had the reputation of understanding construction better than design, he is said to have been a member of the Académie Royale des Arts; BIOG. TOULOUSAIN, 8vo., Paris, 1823, i, 296.

HARDNESS (Fr. *écrouissement*). The firmness given to metals when beaten in a cold state. CASE HARDENING.

HARDOUIN, or HARDUIN, or HARDOIN, of France, commenced 1300 (AICARD, *Patria*, 8vo., Paris, 1847, 2148; DUSIEUX, *Les Artistes*, 8vo., Paris, 1851, 259), the church of S. Petronio at Bologna in Italy; but it was commenced 7 July 1390 by A. Vicenzi or di Vicenzo, as stated herein s.v. BOLOGNA, p. 104; the façade is still unfinished. SCHORN is mentioned as stating the date 1390, and by Master Harduin, in VASARI, *Lives*, etc., edit., 8vo., London, 1850, i, 46.

HARDOUIN (JULES), see MANSARD (J. H.)

HARDOUIN (MICHEL) was a pupil of his uncle Mansard, from whose designs he etched the ground plan, sections, and elevations of the royal castle of Clugny near Versailles, spelt Claigny by GANDELLINI, *Not. Istor. de gl' Intagliatori*, 8vo., Siena, 1771, who calls him *contrôleur* of the royal buildings. He left also four folio views of the castle, 1678. 68.

HARDTMUTH (JOSEPH) was born 20 February 1752 at Aspern on the Zaya, in Lower Austria. He was educated by his uncle Meisl, for whom when still quite young he executed

the plan for the restoration of the prince Lichtenstein's palace at Eisgrub, and conducted the works after the decease of Meisl. He subsequently built the Oriental tower in the park at Eisgrub; and was named *baudirector* by prince Joh. Lichtenstein. In this capacity he conducted all the immense buildings and their accessories (*anlagen*) on the domains at Eisgrub, Feldsburg, Lundenburg, etc. His "inventions" are recorded in the *Oesterreichische National Encyclopädie*, ii, 316. He died 23 May 1816. 26. 68.

HARDWICK (THOMAS), F.S.A. (1780), born in 1752, was the son of Thomas Hardwick of New Brentford, Middlesex, where he resided on his paternal estate, and for the first few years of his life carried on the business of a mason; subsequently following the profession of an architect, he was much employed in various ecclesiastical buildings, among which were the church at Brentford, that at Hanwell (rebuilt), etc. The son became a pupil of Sir William Chambers, and obtained 1768 the first silver medal offered at the Royal Academy in the class of architecture; he exhibited designs 1772-6; again on his return from the continent 1780-6, and down to 1807. His tour lasted three years: during his residence in Rome he made studies of the Colosseum, and had a large model in cork made of it from his drawings, which was presented by his family to the British Museum.

In 1787-90 he designed the church of S. Mary the Virgin at Wanstead in Essex, in Portland stone, at a cost of £9,000 (given in STIEGLITZ, *Plans*, etc., fol., Paris, 1801, pl. 53-4): 1788 repaired the church of S. Paul, Covent Garden, the reputed design of Inigo Jones, by casing it with Portland stone, and rebuilding the rustic gateways in stone; he also rebuilt the church after its destruction by fire 17 Sept. 1795, adhering as closely to the original work as circumstances would permit (BRITTON and PUGIN, *London*, 8vo., 1825-8, i; the roof, 50 ft. span, is given in NICHOLSON, *Diet.*, s.v.): cir. 1790 erected S. James's chapel, Pentonville-row, New-road: 1792 the chapel with cemetery attached in the Hampstead-road, for the parish of S. James, Westminster: 1790-1 examined and reported upon the state of the old church of S. Bartholomew the Great, West Smithfield, prevented its being taken down, and by some repairs then executed under his advice that ancient structure was preserved; he presented three drawings of it, from measurements, to the Society of Antiquaries: made a design, under the Act of Parliament 1802, for a new gaol for county Galway, after that at Gloucester, under the inspection of W. M. Pitt, esq., M.P. for Dorsetshire; it was subsequently carried out under the superintendence of Capt. R. Morrison (HARDIMAN, *Galway*, 4to., Dublin, 1820, 302): 1809 designed S. Pancras work-house, King's-road, Camden Town: and 1814 the chapel with cemetery attached, at S. John's Wood, Regent's Park. For the same parish he also designed 5 July 1813-7, a large chapel in the New-road, and when the building was nearly completed, the vestry determining to enlarge it, the Corinthian portico on the north front with other architectural decorations in Portland stone were added, and the edifice became the parish church of S. Marylebone; it accommodates 3,000 persons, and cost about £60,000 (BRITTON and PUGIN, i). About 1808 he was appointed architect to the royal hospital of S. Bartholomew in West Smithfield, and restored 1823 the small church of S. Bartholomew-the-Less, within the hospital precincts. In 1810 the appointment of resident architect (then denominated clerk of the works) at Hampton Court palace was conferred on him by king George III under the royal sign manual, an office he retained until his death. His practice as a surveyor was very extensive.

Hardwick wrote a memoir of Sir W. Chambers, prefixed to that author's *Treatise*, etc., edited in 1825 by G. Gwilt; and was an original member of the Architects' Club in 1791. He died 16 January 1829, at No. 55, Berners-street, aged 76; and was buried in the family vault in S. Lawrence churchyard at Brentford. The celebrated landscape painter J. M. W. Turner,

R.A., was for a time in Hardwick's office, being desirous of studying architecture as a profession, but ultimately pursued the sister art by his advice: amongst several pupils were the late John Foulston of Plymouth; Samuel Angell; and his son Philip Hardwick, R.A.

HAREHILLS STONE. The stone which goes by this name is quarried at Harehills and at Gipton Wood, in close proximity to one another, and distant about two miles from Leeds, in Yorkshire. Some years since there were two quarries worked at Harehills, and another at Gipton Wood, which may account for the former place having given its name to the stone; there is now only one quarry worked at the former, but two at the latter place. In discussing the quality of the stone from these quarries, and in speaking of them *generally*, both are included on account of their great resemblance to one another; and though they do not differ in *kind*, yet in *quality* the Harehills is uniformly the better stone of the two; though perhaps the best beds at Gipton Wood are not inferior to any of those at Harehills. While the upper and lower beds at Gipton Wood display great disparity in their quality (the lower beds furnishing by much the better stone), there is little if any disparity in the quality of the stone taken from any part of the Harehills quarry. The Harehills, and the lowest beds of the Gipton Wood stone, in their 'green' or newly-quarried state, present the usual appearance of fine siliceous stones; but the upper beds of the latter, when newly quarried, are excessively soft, and never prove so durable as the rest, yet it is much more so than many stones which are at first sight more promising. Consequently, great caution is necessary in obtaining the true stone from the Harehills quarry, when the best stone is required.

The Harehills quarry supplies a very fine-grained sandstone, compact in structure, and of a beautiful warm and unvaried tint: it rejects the lichen in country districts. It is not quite so easily worked as the Bath, but more so than the Portland stones. The laminae are very seldom visible, as if the stone had not been formed by a deposit, and the bed of it is often difficult to be discovered even by an experienced eye. This is best ascertained by the appearance which the mica presents; the plates, although very small, imparting, especially in the sunlight, a brilliant appearance to the bed, at all times far more than to the face, and more to the bed of this than to that of many other fine-grained sandstones. It is usual to specify that the Harehills stone shall be placed on its natural bed; though if it were safe to exempt any building stone of this kind from such restriction, the Harehills might be the exception. This material presents also another remarkable instance of a building stone not depending upon a firm mechanical structure for its durability so much as upon the arrangement and combination of its chemical elements; for it has in many instances stood perfectly well and uninjured the test of time, whilst other stones, which have been used in the same district, and which have been preferred for their firmer structure, have crumbled away.

Harehills stone lies on an average about 14 or 15 ft. below the surface of the ground. Between the thin crust of loose soil and the stone there is scarcely anything but rubbish. The top beds of all the quarries consist of 'rag' stone averaging from 9 to 15 ins. thick, but which may be cleft into whatever thickness is desirable; this is used for the foundations of second- and third-rate buildings, being only removed from its place in the quarry because it is indispensable to do so to get at the 'block' stone under it. Beneath this is a bed of flag or coping stone averaging 3 or 4 ft. thick; this is not to be commended for street causeways or for dwelling houses, as it is too porous to exclude water of itself, and is ill adapted to resist the action of the feet; it is therefore seldom used for these purposes in Leeds: it is, however, well adapted for copings, and for slab chimney-pieces. Immediately beneath this bed lies the 'block' stone, for which the quarries are mainly valuable. The beds are re-

markably disposed; a parallel bed is never met with, for in nearly every case they decline almost to a feather edge on the one hand, and rise to a considerable thickness on the other; the dip of the stone forms in some places an angle of 30°, whilst in others it is almost imperceptible. Occasionally blocks 3 ft. thick are quarried, but this is an exceptional size, and if required, very great delay may ensue, blocks one-half or one-third that size being generally shaped for use. At both quarries the thickest stone is obtained from the lowest beds, which until very recently have not been worked in consequence of their perpetually standing in water.

Harehills stone is to Leeds, what Bath and Portland are to London, or Craigleith to Edinburgh. It is the stone nearest at hand, the easiest to work, and is, as time has proved, the most durable of all the finer stones which can conveniently be used without great expense. Until about 1856 it was almost the only stone of its kind employed by local architects, but latterly it has been passed over by those unacquainted with its excellent qualities, for others which seemed to be more durable, from their firmer mechanical structure, such as those quarried at Park Spring and at Sturdy Bank; the former, a beautiful stone in appearance, has not proved durable; while Harehills stone has been used in several public buildings, such as the Leeds and Yorkshire bank; the stock exchange; the county court; the philosophical hall; etc.; and in private houses innumerable, with great advantage. This stone was used in London in constructing 1830-4 the Westminster bridge, in Francis-street, Tothill Fields.

A. W.

HÄRESLEB (ADAM), *baumeister* to S. Stephen's church at Vienna, died at Kuenring in Austria 9 September 1683, aged 61 years.

26.

HARE WOOD. A variety of sycamore so called, richer in figure and sometimes striped, but otherwise similar to the common sycamore: some of the foreign kinds are beautifully rippled or waved, almost as richly so, as satin woods; these are selected for the backs of the best violins; *HOLTZAPFEL, Woods*, etc., 8vo., London, 1843. This term is said to be used from its similarity to the skins of hares when the long coating is removed. The name has also been written 'air wood', and specimens, grey in colour, are often imitated in decorative painting, as in the concert room of S. George's hall at Liverpool. By some writers this 'air wood' is supposed to be the produce either of the sattans of Central Asia, or of the grey mangrove or wave tree of Trinidad, and of the airie tree of Africa; these are woods of a grey colour, and used in decorations in those countries.

HARGRAVE (ABRAHAM), born near Horsforth, Leeds, Yorkshire, was with his relative and countryman T. Harrison, at the erection of some of his works at Lancaster. He then went to Ireland to superintend the erection 1791 of S. Patrick's bridge over the river Lee at Cork, which fell a few years since, and was rebuilt 1859-60 by his grandson Joshua Hargrave. Becoming an extensive contractor, he undertook, as usual at that period, the design as well as execution of many of the following works (with his eldest son ABRAHAM the Tontine buildings, Camden quay, Cork); Castle Hyde mansion for Colonel Hyde; and a Gothic church for him, not executed; a bridge for foot and carriage traffic, of one arch 280 ft. span, across the river Blackwater in front of the house, connecting the two sides of the estate; this was put up in six weeks, of green timber cut from the neighbouring plantation; it stood for nearly forty years, and then succumbed to the dry rot: at Ballyhooley, higher up, a bridge of rubble limestone, the arch stones being hammer dressed: at Fermoy, lower down the river, was the fine specimen of an old Irish bridge, of seventeen or nineteen arches, with recesses in the parapet walls for foot passengers; this he widened on the upper side; but it is now being rebuilt of seven arches by his grandson: also, in part, 1790-8 Shanbally castle, Clogheen, the seat of Lord Lismore: planned the quay, of considerable

length, at Cove, now Queenstown, Cork harbour, formed of cut limestone ashlar blocks, for the late James H. Smith Barry, esq., of Foaty, at whose house he effected some alterations: the market house at Cove: on the north side of Cove, at Bellvelly castle, Ford, a bridge of three arches of rubble limestone, the arch stones being partly hammered and partly chiselled; the seat of councillor Franklin at Ashgrove, in the same island; Hoddersfield mansion, for Colonel Hodder, on the west side of Cork harbour; Ahada house, on the east side, for John Roche, esq.; in Fermoy about 1800-10 a large church in Portland stone; Lota house, Glanmire, co. Cork, for the first baronet, Sir R. Kellete; 1800-8 the barracks at Cork; the first one at the north-east part of Fermoy; and that at New Bridge, co. Kildare. Bally Edmond, co. Cork, the seat of Robert Courtenay, esq., was restored by him and his son ABRAHAM. Prior to the commencement of this century he proposed to Mr. Wickham, under secretary to Lord Cornwallis, to erect a bridge of a single arch over the river Lee, at the Giant Stairs below Passage, near Cork, having an immovable and solid abutment in the stairs, and only requiring the erection of another on the opposite side; the conception, however, was not carried out, the execution being questioned. He died at Cork 20 March 1808. ABRAHAM, his son, died at his seat, Ballyno, co. Cork, in March 1838. His grandson HENRY is engaged as a civil engineer on the Great Bombay and Baroda railway. W. H.

HARGRAVE (JOHN), the third son, was an articled pupil of T. Harrison of Chester. He settled in Ireland, and designed a handsome castellated tower at the north-west end of Foaty island, near Cork; an entrance gateway with approaches to Foaty demesne, for the late J. H. S. Barry, esq.; a mansion for Major Travers on the Lee above Sunday's Well; Glanworth bridge, co. Cork; the court house and gaol at Mullingar; the gaols at Omagh, and Naas, co. Kildare, and Longford; Moate sessions house, with the gaols at Trim, co. Meath; plans for Castle Forbes, co. Longford, for Lord Forbes, parts of which were executed; a mansion at Cappoquin, co. Waterford, for Captain Healy; Doory hall, co. Longford, for Mrs. Jessop; Coolamber house, co. Longford, for Major Blackall; a residence in co. Tyrone for Sir H. Stewart Ballygawley; others at Letterkenny, co. Donegal; for Sir — Stuart at Ards, and Dan. Chambers, esq.; gave designs for Lord Darnley at Athboy, co. Meath; a church at Ballinagall, for — Gibbons, esq.; with plans for his house, co. Longford; a residence for Capt. Bond, in the same county; and a church about 1828 for the rev. Dr. Craufurd at Ballinalea or Ballynagall, co. Westmeath. Whilst sailing in his yacht in the bay of Cardigan, North Wales, he was wrecked, with his only son John, and the greater part of his family, 30 August 1833, in the forty-fifth year of his age. William Hargrave, M.D., the fourth son, resides in Dublin. W. H.

HARINGER (KARL JOSEPH) was about 1731 at Olmütz in Moravia. He designed the following works, engraved for the ENTHRONISTICON PARTHENON by A. and J. Schmutzer at Vienna: *The Triumphal Arch of the Church of the Holy-mountain near Olmütz*, bearing the inscription "Car. Jos. Haringer, Pict. et Architect. inven. et fecit Olomucii"; with an interior view of the same building; *The armorial coat of the cardinal Hannibal Albani*; and *Portæ triumphalis primariæ latus sinistrum*. 20. 26.

HARLAS. This term occurs in a Norman-Saxon poem, cir. 1300, quoted in WARTON, *Hist. of English Poetry*, 8vo., London, 1840, i, 9:

"The pilers of that cloister alle
Both turned of cristale,
With harlas and capitale
Of grene jaspé and rede corale."

It is mentioned by WILLIS, *Nomenclature*, 4to., Cambridge, 1844, but without any explanation of its meaning. A correspondent has suggested that the word is a misreading for 'harbas and capitale', i. e. 'their base and capital'.

ARCH. PUB. SOC.

HARLE or HARLING. A term used in Scotland; thus, "The whole of the rough walls to be pointed and harled (rough cast) outside, and the whole to be pointed within." LONDON, *Cottage, etc., Arch.*, 8vo., London, 1838, p. 527. The outside face of a rubble wall is covered with thin mortar mixed with small stones about the size of beans and peas, and thrown on the wall with a flat square trowel used for the purpose; the joints of the masonry are previously raked or cleared out. In better works the wall is coated over with plaster, into which, before it is dry, the small stones penetrate and adhere. At Glasgow, slaters perform this operation of harling, but in other parts of the country, masons are employed. DEFRETER.

At Aberdeen 'sneck harling' is harling up the joints, leaving the face of the larger stones exposed; it is not so neat an operation as pointing: 'dead harling' is overcasting the whole surface, unless there are margins or other dressed work. J. T. HARLESTON QUARRY. This stone was used at Spratton church, Northamptonshire, but whether in the Early Decorated work, or in the "late restorations", is not clearly stated. *Churches of Northamptonshire*, 8vo., London, 1849, 245.

HARLEWIN, see HERLEWIN, abbot of Glastonbury.

HARMONIC PROPORTION IN ACOUSTICS. It is said that large rooms, the dimensions of which bear the relation of certain equimultiples to each other, are peculiarly favourable to sound, either for music or speaking. The reason given is, that the waves of sound will recur at regular intervals, and do not clash with, or jar against, each other. Suppose a room 20 ft. high, 40 ft. wide, and 80 ft. long, the quickness of the recurrence of sound would be in inverse proportion to the distance. In other words, two reverberations would be got from the side walls with only one from the end, and two from the ceiling to one from the walls, or four from the ceiling to one from the end. But at the same instant that the sound is reflected from the end, there would also be one of those from the walls, and one thrown down from the ceiling. Assuming that sound travels ten feet in the hundredth part of a second (which is nearly the fact), at every $\frac{1}{100}$ th part of a second there would be a simultaneous reverberation from the end, sides and ceiling of the room. If the dimensions of the room bore no definite proportions to each other, or were incommensurable, the sounds would recur at irregular intervals, and fall confusedly on the ear. Harmonic proportions, however, differ considerably. Perhaps the best acoustic building ever erected was the Surrey music hall, now burnt down. Here the proportions of height to width and length were exactly 2 : 3 : 5. The free trade hall at Manchester has the proportion of 2 : 3 : 5; the music hall at Edinburgh those of 6 : 8 : 15. These are all excellent for hearing; while Exeter hall, of which the dimensions are 45 ft. high, 77 ft. wide, and 131 ft. long, all incommensurable numbers, is by no means good for hearing. One singular instance is the music hall in the Manor house, Hackney. It has a flat ceiling, and, what is a serious drawback in any room, a deep recess with columns in the middle of one side; the proportions are 2 : 3 : 6; but it is a good room notwithstanding.

Of course the reverberation in a room depends upon other circumstances, as on an arched or coved ceiling, on rounded ends if the room be long, and on very many other causes. A list of publications on the subject, and the general principles of the science, are given s.v. ACOUSTICS; and by SMITH, *The Acoustics of Public Buildings*, 12mo., London, 1861. GEOMETRICAL PROPORTION OR RATIO; ISACOUSTIC CURVE; MUSIC HALL AND ROOM. A. A.

HARMONIC PROPORTION. The proportion which exists in a series of quantities when, any three adjoining terms being taken, the difference between the first and second is to the difference between the second and third as the first to the third; e.g. if the terms be 6, 3, 2, then 3 : 1 :: 6 : 2.

HARMONIC SERIES. A series of many numbers in continual harmonic proportion. If there be four or more numbers, whereof every three immediate terms are harmonic,

the whole makes a harmonic series of continual harmonic proportionals; as 30:20:15:12:10. Or if every four immediately next each other are harmonic, it is also a continual harmonic series, but of another species; as 3, 4, 6, 9, 18, 36, etc.; as explained s. v. HARMONIC PROPORTION. 13.

HARMONY. Upon the recognition of the existence of precise and simple arithmetical relations between the parts of the human figure, sculptors were enabled to establish canons of beauty. Upon the discovery of equally precise and simple arithmetical relations between sounds, musicians founded laws for the employment of those sounds (in sequence) melody, and in (consonance) harmony. It has been frequently argued that painters and architects should find, in the relations between colours and between forms, similar bases for equally strict regulations. But the painter has not yet obtained applause for any works professedly framed upon any discovery of precise and simple arithmetical relations between colours: and the architect has not yet founded a criticism of a rival's work upon any system of precise and simple arithmetical relations between solids and between voids (but see above HARMONIC PROPORTION). It is curious, however, that in all attempts made to assist the painter and the architect in the discovery of such relations, the term *melody* has been omitted, and only *harmony* mentioned, except by FIELD, *Analogy, etc., of Colours*, 4to., Lond., [1817, p. 15. It is equally curious that writers upon harmony of form and of colour have not seen the expediency of defining the term, so as to let the reader see at once the meaning attached by them to it: but it may be supposed that in the case of each subject, the word must be taken in the most modern and extended sense, viz. "an agreeable effect", which is the pith of the usual musical definition of harmonic composition, viz. "the art of disposing and concerting several single parts together in such a manner as to make an agreeable whole."

HARMONY. The accuracy with which the blocks of stone were united in Greek structures was so remarkable, that the close fitting of the contiguous blocks was called *ἀρμονία*, as in PAUSANIAS, ii, 25; viii, 41; ix, 33, 39; upon which fact WILKINS, *Atheniensia*, 8vo., London, 1816, p. 124, remarks that thence perhaps arose the fabulous creation of the walls of Thebes by the power of music, or of harmony.

HARMONY OF COLOUR. As pigments cannot be obtained to truly represent each primary colour, either in respect of purity or power of mixing, an explanation of the laws of harmony is beset with many difficulties; REDGRAVE, *Elementary Manual*, 16mo., London, 1853, makes no attempt, but dogmatically teaches, in accordance with the theory propounded by FIELD, that a perfect secondary harmonizes with the remaining primary: that to produce harmony of colour, the presence of all the three primaries is required, either pure or in combination: that a perfect tertiary harmonizes with the remaining secondary: and that if uncomplementary colours touch each other, the introduction of a line of white to divide them greatly modifies the injurious effect; the eye readily decomposing for itself the harmonizing colour required, and resolving the discord: on all these points, and in the illustrations of them, he proceeds upon the assumption that the proportions essential to harmony of material colours are, blue 8, red 5, and yellow 3: these proportions seem, however, to be very doubtful, as they do not accord with BREWSTER, WOLLASTON, FRAUNHOFER, and others, nor with the results of other experiments made in the same way as those by FIELD, as by LEWIS, *Description of the Panopticon Inst.*, read at the Royal Institute of British Architects 18 April 1853; and *Some Researches on Colour*, etc., 17 Nov. 1862, who asserts these proportions to be blue 8, yellow 5, and red 3. Consequently opinions would differ as to which was able, except empirically, to produce harmony. Even the simplest arrangements of colour (viz. combinations of the primaries and secondaries in their perfect state as full hues) require, in order to be perfectly harmonious, great skill in their distribution: and combinations of the mixed primaries with

secondaries of different numeric proportions to those which form them in their perfect state, require a nice sense of relation, and, in the present state of the science of colour, depend more on the educated eye, or on a fine organization, to regulate their harmonies, than on any fixed rules of proportion. Yet after a confession, that leaves the subject in a confusion not very creditable to the present state of science, FIELD concludes by observing that the primaries not only harmonize with the secondaries, and these with the tertiaries in their state of full hues in his before-mentioned proportions, but their tints also harmonize: that the luminous primaries and secondaries also harmonize in their full hues with tints of their dark complementaries, but that in these cases the surface of the contrasting tint must be increased in proportion to its dilution with white: and that where a dominant colour is used in large masses, the primaries or secondaries may be used neutralized into shades, and the harmonies obtained by the introduction of small portions of the pure complementary: of course the whole of these proportions would be materially modified if the modern theory, that there are only two primary colours, should be established. FIELD, *Analogy and Harmony of Colour*, 4to., London, 1817, p. 23, insisted "that there can be no perfect harmony of colours in which either of the three primaries (simple or compound) is wanted; and that the distinctions of harmony depend upon a predominance of one, and a subordination of the other two in the composition." Perhaps the only results from experiments, made from the time of JURIN to that of FRAUNHOFER, were propounded partly by BUFFON and partly by GOETHE as to complements; and by CHEVREUL as to contrasts. These, considered by the latter author under the classes of simultaneous, successive, and mixed contrast, regulate two genera; viz. harmony of scale, of hues, and of a dominant coloured light, being the three species in harmony of analogy; and contrast of scale, of hues, and of colours, being the three species in harmony of contrast. FIELD, *Chromatography*, 4to., London, 1835; BREWSTER, *Optics*, 12mo., 1853; HAY, *Laws of Harmonious Colouring*, 8vo., 1858; *Principles of Beauty in Colouring*, 8vo., 1845; and *Nomenclature of Colours*, 8vo., 1845; JONES, *Attempt to Define the Principles*, etc., 8vo., London, 1852; CHEVREUL, *Loi du Contraste simultané des Couleurs*, etc., 8vo., Paris, 1839; transl. by SPANTON, 8vo., 2nd edit., 1860; and by MARTEL, 8vo., 1854; GOETHE, *Theory of Colour*, transl. by EASTLAKE, 8vo., London, 1840.

HARMONY OF FORM. The practice of the classic architects seems to have been based upon an artificial dimension, the *ἐπιδάς* or *modulus*: while the works of the mediævalists appear to have been erected upon an existing measure, the *yard*; except in such cases as the system propounded by RORICZER in 1485 (given in ARCH. PUB. SOCIETY, *Essays*, etc., fol., Lond., 1850), and somewhat slightly in the records of the disputes regarding the designs for the works at the cathedral in Milan. The discovery by HAWKINS, *Gothic Arch.*, 8vo., Lond., 1813, of the diagrams of CÆSARIANUS in *Vitruvius*, fol., Como, 1521, seems to have revived the attempts to render a building dependent, for its beauty in execution, upon the accidents of geometric diagrams; but little trouble has been yet taken to ascertain whether arithmetic received more attention than geometry from builders in classic and in mediæval times. The latest method followed is that called the interaxal system noticed in the last three sections of GWILT, *Encyc.*, iii, 2 (2842-60): which, with 13 ft. assigned as the measure of each space, is stated to have been used before 1841 in the design of S. George's hall and the assize courts at Liverpool, *Builder Journal*, 1855, xiii, 1; while 24 ft. was adopted in the building of the Exhibition of Industry at London in 1851.

It has been assumed that harmony of form could be positively produced in four ways, namely, arithmetical, geometric, harmonic (strictly so called), and sesquialteral proportion; to which may be added interaxal division, and the modern theories of harmonic (so-called) systems.

Amongst the most ardent propagators of a faith in harmonic systems may be named GRIFFITH, *Geometrical Proportion*, 4to., London, 1843; *Ancient Gothic Churches*, 4to., 1850-2: HAY, *Natural Principles and Analogy of the Harmony of Form*, 4to., Edinburgh, 1842, being an attempt to show that forms are in all respects analogous to sounds, and that consequently a system of linear harmony can be established similar to that which regulates the arrangement of musical notes: HAY, *Proportion*, 4to., Edinburgh, 1843, wherein harmony, as a particular element of beauty, is defined as meaning, in a general sense, "the adaptation of the parts of anything one to another, or the just proportion of sounds, colours, forms, words, or sentiments", which seems to be the symmetry of VITRUVIUS, the unity of proportion between all the parts and the whole: HAY, *First Principles of Symmetrical Beauty*, 8vo., 1846, applying the numerical harmonic ratios to the proportioning of rectangular forms; a criticism by PURDIE is given in the *CIVIL ENGINEER Journal*, 1848, xi, 148: HAY, *Proportion*, 4to., 1843; and *Application of the Harmonic Law of Nature to the Parthenon*; and to the *East End of Lincoln Cathedral*; the two latter read respectively 7 Feb. 1853, and 13 Nov. 1854, at the Royal Institute of British Architects: where was also read, 4 June 1847, CHANTRELL, *Geometrical System applied by the Mediæval Architects*, given in *BUILDER Journal*, v, 300; which also, p. 2, has an article *On the Seven Architectural Harmonies or Proportions*: BILLINGS, *Infinity of Geometric Design Exemplified*, 4to., Lond., 1849; and *Power of Form applied to Geometric Tracery*, 8vo., Lond., 1851; a paper also by him entitled *Attempt to Define the Geometric Proportions of Gothic Arch.*, and that by WALLER, paper read before the Yorkshire Polytechnic Society, are both referred to in the article *On the Philosophy of Gothic Arch.*, in *ENGLISH REVIEW*, No. IV, Decr. 1844. With these should be named FREEMAN, *Proportion in Gothic Arch.*, 8vo., Camb., 1848: WHITE, *On Modern Design*, in the *ECCLÉSIOLOGIST Journal*, 1853, new series, xi, 313: CRESY, *Encyc. of Civil Engineering*, etc.; LLOYD, *General Theory of Proportion in Arch. Design—in the Parthenon*, read at the Royal Institute of British Architects 13 June 1859; and further detailed in COCKERELL, *Basse*, etc., fol., London, 1860: and HENSZLMANN, *Théorie des Proportions appliquées dans l'arch., depuis la xii^e dynastie des rois Egyptiens jusqu'au xvi^e siècle*, 4to. and large fol., Paris, 1860 (in progress).

Earlier writers, besides the remarks by CESARIANUS and others mentioned in the text, are CRISTIANI, *Della media Armonica Proporzionale da applicarsi nell' Arch. Civile*, 4to., Brescia, 1766; MORRIS, *Lectures on Arch.*, 8vo., Lond., 1734; MURPHY, *Plans, etc., of the Batalha*, fol., Lond., 1795; STIEGLITZ, *Geschichte der Baukunst*, etc., 8vo., Nuremberg, 1827; and HOFFSTADT, *Gothisches ABC buch*, 8vo. and fol., Frankfurt, 1840.

HARMUS (Gr. *ἄρμος*). The Greek term for the rim worked on a stone for a tile in roofing; according to the explanation given of the use of certain stones described in four passages of the inscription regarding the state of the Erechtheum at Athens, in WILKINS, *Prolusiones*, 4to., London, 1837, pp. 69-72; who considers that the rim would be worked on one side to receive the tail of the upper tile, and be returned on the end to receive the cover-joint. It is clear that GWILT, *Encyc.*, and BATISSIER, *Histoire*, 8vo., Paris, 1845, p. 177, state erroneously that the *harmus* was the tile used for covering the joint between two common tiles, a view which had been held by WILKINS, *Atheniensia*, 8vo., London, 1816, pp. 204, 213. The word has also been explained with equal inaccuracy as meaning the mask in the cymatium, and the antefixæ; the error in the latter case arising from the dubious nature of an explanation incorrect in itself; viz. the check or stop of a covering or joint tile. WILKINS considers the large stones referred to, to have been those which tail down the cornice and were worked as the lowest course of the stone tiling. **HARMONY**.

The inscription is also given in *INSCRIP. ANTIQ.*, fol., Oxford, ARCH. PUB. SOC.

1774, and in CANINA, *Archit. Greca*, 8vo., Rome, 1837, pt. ii, c. 4. In the latter part of it is an account of "stones half worked lying on the ground"; the word occurs under four heads and has three designations, *ὁ ἄρμος*, *ὁ ἄρμος ὁ ἔρεπος*, and *οἱ ὀπισθεν ἄρμοι*; the *harmus*, the other *harmus*, and the back *harmus*; and is used in such passages as "twelve stones, 6 ft. long, 2 ft. wide, and 1 ft. thick, of each of them the other *harmus*, and the back *harmi* are incomplete (*ἐξέλεργασται*, literally, not worked out)." As noticed above, the definition of the term is uncertain, but no one appears to have considered that a stone of the size mentioned, weighing about three parts of a ton, was not applicable to a tile. LIDDELL and SCOTT translate 'harmus', as "a fitting, a joining, a joint"; and in SOPHOCLES, *Antigone*, 1216, the herald orders the servants to open the tomb by removing the stone at its mouth by the joint (*ἄρμον*). Most probably the 'harmus' was the tooled draught wrought on the edge of the stone so as to form a close joint on setting it, as done at the present day; the remainder of the bed and joint being only roughly pointed to give a better key to the mortar. If this explanation be correct, *ἄρμος* would mean the front joint or tooled draught; *ἔρεπος*, the side draught; and the other term, the inner or back draught. **DRAUGHT**; **MASONRY**; **PLINTNOS**.

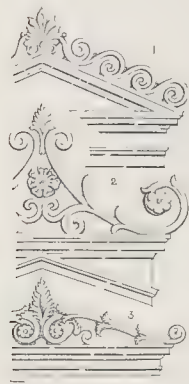
HARNESS ROOM. The place in large stabling appropriated to the reception of clean harness, etc. The most expensive accommodation of this nature is a plastered room with oilcloth on the floor, and artificially heated, and in which are placed drawers and cupboards. As both drawers and cupboards are now found objectionable, it is better to regard the room itself as a closet, to line the walls with boarding, to put a stove in a wall that divides the harness room from the cleaning room, and to replace the drawers by trays in presses, if the groom folds rather than hangs summer clothes, rugs, etc. As the floor may get scratched, kamptulicon on boards may be recommended; but if the floor is to be left bare, paving or asphalt is thought better for the purpose than boarding. The stove will be more useful if provided with a boiler having a tap in the cleaning room. Wooden pegs and pins for the trappings have been superseded by brackets and hooks, sometimes made of brass, but more usually of iron: if the latter metal be employed, it is better covered with blacked leather than painted. A stable for three carriage horses and two saddle horses, requires brackets for five collars, and for four saddles, but more brackets should be provided, as these articles are likely to accumulate. Hooks are required for each portion of the rest of the trappings, viz. single harness; dress, and plain, double harness; bridles; stirrup leathers; girths; etc. It is thought advisable to hang the double suits of clothing, saddle cloths, etc., on poles resting on hooks, rather than to place them in trays. Driving whips should hang on blocks of wood turned to fit the crop; and riding whips should be put in a rack.

The harness of farm horses is too often kept in the stable; a fair allowance to each pair of stalls would require five brackets about 18 ins. apart for two cart saddles, one pair of bridles, the plough harness, the trace harness, and hooks for cart ropes and for plough reins, with places for currycomb, mane comb, foot pick, and brush to each pair of stalls; but even for these a separate room is desirable, even if it be also the cleaning room. The latter room requires a paved floor, fire, boiler, supply of cold water, sinkstone, and places for drinking and cleaning pails, mops, brushes, lamps, stuffing boxes, etc., besides trees, brackets, and hooks for the harness that is being cleaned.

HAROU-ROMAIN (. . .) the elder, was architect to the department of Calvados; in 1818 he projected the extensive maison centrale de détention at Beaulieu near Caen, and published 1820 a lithograph view. On his death in 1822, his son succeeded to the appointment; the cloisters were commenced 1823, and the building carried out 1828-42, when,

much of it having been destroyed by fire, it was rebuilt 1842-4: plans, etc., are given in GOURLIER, *Choix d'édifices*, etc., fol., Paris, ii, pl. 298-300.

HARPAGINETULUS, APAGINA, APAGINIS, APAGINETULUS, APARINA, and ARPAGINETULUS. A term used by VITRUVIUS, vii, 5, in the passage "pro columnis enim statuuntur calamos, pro fastigiis harpaginetuli striati cum crispis foliis et volutis teneris." It is one of those, which so much troubled the commentators, as to have led some to a suspicion that the word was an error; a belief that may be said to have been negated by the discovery at Resina of a painting, engraved in the *PITTURE DI*



ERCOLANO, fol., Naples, 1757, i, 209, which exhibits portions so far resembling the following sketches, figs. 2 and 3, as to justify the idea that they show the feature of which he complained. Similar ideas are exhibited in the same work, ii, 251, 259, and iv, 9; and in the *Ornati delle Pareti*, etc., dell' *Antica Pompei*, fol., Naples, 1796, and 1808; all may be assumed

to be merely a decorator's application of a system of ornament adopted in sculpture, as fig. 1, given from an example at Aizani, in FELLOWS, *Asia Minor*, 8vo., London, 1852, p. 109.

HARPY. The harpies, Gr. ἄρπυιαι, "the swift robbers", appear in the earliest times to have been regarded as fair-haired and winged maidens, perhaps personifying storm winds or hurricanes; but so early as the fifth century B.C. they are described as ugly winged creatures; and by VIRGIL, *Æneid*, iii, 216, as birds with the heads of women and with long claws on their hands. A border of harpies in the tablinum of the house of the Tragic Poet at Pompeii, in the form in which they are usually given, may be added to the list of examples given by FELLOWS, *Introductory Remarks to Lycia*, etc., 8vo., London, 1847, p. 10-16, wherein the several varieties of type are given (notice being taken of their relationship to Egyptian and Persepolitan sculptured images); the most remarkable being that of the bird with human arms and breasts, from the Harpy tomb at Xanthus, and that of the draped female with the wings and legs of a bird. LLOYD, *The Harpy Tomb*, 8vo., London, 1844. SIREN.

HARRIS (WILLIAM) was a pupil of Sir J. Wyattville. He joined S. Angell at Paris in 1821, and with him travelled through the south of France to Rome, Naples, and Sicily, assisting in discovering the sculptures at Selinus in the latter country in 1823, in which year he died of malaria at Palermo. A monument to his memory was placed in the burial-ground at Rome; ANGELL and EVANS, *Sculptured Metopes*, fol., London, 1826, p. 9.

HARRISON (PETER), who practised at Newport, Rhode Island, in the United States, about 1760, built the city hall, a building of the Ionic order; the state house; and the Redwood library, of the Roman Doric order, to which a large reading room and picture gallery have since been added; all are monuments of his skill; *BUILDER Journal*, xx, 278.

HARRISON (STEPHEN), who styled himself "joiner and architect", invented (five out of seven of) the triumphal arches erected in London for the reception 15 March 1603-4 of James I. The expense of the five was defrayed by the city companies; the other two were set up by the Dutch and Italians; eighty joiners and sixty carpenters with two master carpenters, with other workmen, were engaged in their construction; JUPP, *Carpenter's Company*, 8vo., London, 1848, p. 71. The designs were published by HARRISON, *The Arch of Triumph*, fol., Lond., 16 June 1604, and engraved by W. Kip;

a few leaves in folio in the library at Chatsworth, were all that had been seen of it by WALPOLE, *Anecdotes*, edit., 8vo., Lond., 1862, p. 251. A copy of this very scarce work is in the Grenville collection in the British Museum; the Society of Antiquaries and the Pepysian library possess others; while that belonging to the corporation of London is imperfect. One of the prints, reduced in size, is given in [NICHOLS], *London Pageants*, 8vo., London, 1831. 112.

HARRISON (THOMAS) was deputy surveyor in 1661 under Sir John Denham at Whitehall and Hampton Court, and received 3s. per day.

HARRISON (THOMAS), born 1744 at Richmond (CLARKSON, *Richmond*, 173; and *Catalogue of the Royal Academy Exhibition*, 1779), or at Wakefield (PENNY CYCLOPÆDIA), Yorkshire, of humble origin, became an excellent arithmetician, with a thorough knowledge of the science of mechanics. In 1769 he was sent with G. Cuit, landscape painter, by Lawrence Lord Dundas to Italy. In 1770, while at Rome, he made a design for pope Clement XIV (Ganganelli) for the decoration of the cortile of the Belvedere as a receptacle for the Apollo and other sculptures, which was approved but not executed. The pope also desired plans for altering and embellishing the piazza near the porta del Popolo, when, after contrary decisions as to the merits of the competitive designs, the pope presented him with two medals of gold and silver, and ordered his name to be added to the members of the academy of S. Luke, with a seat in the council of that body (the medals and drawings are in the possession of his daughter in Chester). Piranesi drew up an elaborate statement of the circumstances connected with the adjudication of the plan. Harrison was also desired by the pope to make a design for an alteration in the sacristy of S. Peter's; it, however, was not carried out, probably in consequence of the pope's death 22 Sept. 1774. He returned to London in 1776; exhibited his medal drawings 1777; visited his birthplace in 1779; and went to Lancaster, where he designed the bridge over the river Lune, of which the first stone was laid by king George III in 1783, and the whole was completed 1788; it has five elliptic arches, each 69 ft. span, is 644 ft. long, and cost £14,000; it was declared to be the first bridge with a level surface erected in the county. In 1784 he built the tower to S. John's chapel. In 1788 he commenced the rebuilding of Lancaster castle as the gaol, adopting the Gothic style on account of the mediæval character of the place; this includes the keeper's house and the male felons' portion, wherein no wood, plaster, or arch was used, the walls inside and out, the floors and roofs, being all finished with hewn stone; and the new county and crown courts and county offices (which had additions 1802-23 by J. M. Gandy); with the arcade in front of the old crown hall and debtors' rooms over; Alex. Hayes being the superintending mason. He also erected the bridge at Derby over the river Derwent; and many others. In 1788 his plans were selected in competition for rebuilding the castle at CHESTER, consisting of a prison, county courts, armoury, exchequer, and gateway; these were executed in the Grecian Doric style, 1793-1820, wholly of stone, no iron or timber being used in any part of the walls, ceilings, floors, or staircases; it is said to have been the first prison erected on the panoptical arrangement in the kingdom. In 1796 he designed Broom hall, Fifeshire, for the earl of Elgin. At Liverpool he designed the athenæum, opened 1 January 1799, containing news and coffee rooms, and public library; where he also erected the lyceum, at a cost of about £11,000; the library of the Literary Society, a room 150 ft. in circumference; and 1810-11 the tower of the church of S. Nicholas. About 1808-10 he erected at Chester the news room; and the north gate, of the Doric order, for Lord Grosvenor; at Manchester, the theatre (burnt in 1843); the library and reading room, called the Portico, or the Athenæum; and the exchange, 1806-8, the chief room being a semicircle 88 ft. diameter; it was greatly enlarged and altered in 1855. In 1812 he designed a timber

bridge over the Mersey at Warrington, Lancashire; and Woodbank, near Stockport (given in Twycross, *Mansions*, fol., Lond., 1847-50); in 1810 he erected the grand and massive obelisk or pile of obelisks on Moel Vamau, in the highest part of the Clwydian range of hills, in North Wales, to commemorate the fiftieth year of the reign of George III; it cost upwards of £6,000, and was much injured in the storm of Nov. 1862; he also erected the commemorative column to Lord Hill at Shrewsbury; that to Lord Anglesea at Plas Newydd near Bangor; and the triumphal arch at Holyhead to commemorate the landing 1821 of George IV. He commenced 1827 the celebrated Grosvenor bridge at Chester over the river Dee, of which the design had been made several years before, consisting of one arch, a segment of 140 ft. radius, having a chord of 200 ft., with a versed sine of 42 ft.; an exact model made of small pieces of stone of the same proportionate size, is in the exchequer chamber of the castle. In consequence of his age and health, the execution was entrusted to the late Jesse Hartley, C.E., of Liverpool, who adhered to the original design, but raised the abutments one foot in height; it was completed 1832.

Amongst his other designs were a house in Clackmannan, Argyshire, for Mr. Bruce of Kennet; a house for the late General (Sir Ralph?) Abercrombie; another for Mr. Potts in Chester; Hardwick grange, Shropshire, for Lord Hill, G.C.B. (NEALE, *Seats*, etc., 1826, ser. 2, iii); the fitting up of the picture gallery at Tabley house, Knutsford, for Lord de Tabley (built by J. Carr of York); and the two ends of the new building at Magdalen college, Oxford, besides general designs for its enlargement. He did not design the façade (1780) of the New-street theatre at Birmingham, although it is often attributed to him. The earl of Elgin having been appointed ambassador to the Porte in 1799, Harrison suggested to him to obtain drawings and casts of the works of art at Athens and other places in Greece, which resulted in the collection known by his lordship's name, afterwards purchased by the government 1 July 1816 for £35,000. He made a design (in 1776-80 says MICAUD in *Biog. Univ.*) for a triumphal bridge over the river Thames, where Waterloo bridge now stands; and addressed a remonstrance to the committee for erecting that bridge on their having adopted (1809-10) a mere copy of the Neuilly bridge over the Seine; whereon they renounced their plan and employed John Rennie to design and execute the present structure. This proceeding led to Harrison's preparing a plan for a quay from Westminster to Blackfriars or London bridge, "the detailed proposals for which are still in existence". He was consulted by count Woronzow, ambassador from Russia; and about 1822 he designed for count Michael, his son, a palace to be built in the Ukraine on the river Dnieper, and a gateway for the triumphal entrance of the late emperor; the range of apartments on the principal floor extended upwards of 500 ft. in length; the design, in the Grecian style, was approved: a tower or lighthouse upwards of 100 ft. in height, was built by the count upon an eminence whence it can be seen from the Black sea.

He died at Chester 29 March 1829, aged 85, and was buried in the churchyard of S. Bride; but no monument or memorial of him exists therein. He left a widow, two daughters, and a nephew James Harrison, in practice (1864) at Chester, whose late brother, John, presented a bust of Harrison to the Institute of British Architects in 1838. Among his pupils was the late John Hargrave of Cork. *ANNUAL REGISTER*, lxxi, 221-2; *GENTLEMAN'S MAGAZINE*, xcix, pt. i, 468-70; *BUILDER JOURNAL*, xxi, 203-5, being a memoir read by the rev. canon BLOMFIELD at a meeting of the Chester Archaeological Institute 1863.

HARRY (JOHN), freemason and master mason at Exeter cathedral, from 1424-5 to 1437-8, was also sent 1427 to Bere to provide stone, probably for bishop Lacy's work, begun about that time; BRITTON, *Exeter*, 4to., Lond., 1827, p. 97; OLIVER, *Hist.*, etc., 8vo., Exeter, 1861.

HARSDORF (CASPAR FRIEDRICH) was born in Denmark
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in 1735, and educated in France and Italy. The academy of Rome admitted him a member; and on his return to Copenhagen was appointed the chief royal architect; he was also professor at the Academy of Sciences at Stockholm, of which he became afterwards director; and in later years he received the title of *justiz-rath*. Harsdorf constructed the propylæa between the two royal palaces on the *platz* where stands the equestrian statue of Christian V; in which he introduced two galleries formed of four ranges of fluted columns of the Ionic order; and he designed 1749 the Frederick's church in Bredgade, at Copenhagen, a copy of S. Peter's at Rome, left incomplete on account of the enormous cost. He also built a pavilion in the gardens of the palace, besides many private edifices. He died in 1799. 68.

HART (ABRAHAM VAN DER) was born at Amsterdam 27 May 1757. He was a member of the Institute of Arts and Sciences; and in 1777 *baudirector* of the public works and general surveyor of the town buildings at Amsterdam, where he designed the French and German theatres; the barracks; the Roman Catholic female orphan house and chapel; 1778-82 the workhouse for 400 persons (given in GORTHEBUER, *Choix*, fol., Ghent, 1827, p. 63); and several private houses in the city and elsewhere. His design for the monument in commemoration of the battle of Quatre Bras obtained in 1816 the first premium, and was erected before the pavilion of the prince of Orange at Soestdyk. He died at Amsterdam 3 February 1820 aged 62 years; or 7 Feb., aged 73, according to another author. B. W. H. Ziesenis was a pupil. 24. 68.

HARTFORD BRIDGE STONE, obtained from a quarry near Morpeth in Northumberland, is a very strong quartzose grit, of a uniform light grey-brown colour, capable of resisting the weather in an extraordinary degree. The bridge at Hartford, built of this stone, is said to be six hundred years old; the marks of the chisel thereon are still visible. This stone has been used for building S. Stephen's church, Rochester-row, Westminster, 1847-50; and for improvements at Windsor bridge. It carries a fine edge, and can be carved into the most intricate forms: *BUILDER JOURNAL*, ix, 639.

HARTLEY'S FIREPROOF FLOOR was invented by David Hartley, M.P. for Hull, before 1774, in which year the sum of £2,500 was voted him by the House of Commons; in 1777 the validity of the patent was extended for thirty-one years from that time; and in 1776 an obelisk was erected on Putney heath by order of the Corporation of London, to commemorate the satisfaction of that body with experiments then made by the inventor of the system, who published them in *An Account of the Invention and Use of Fireplates for the Security of Buildings and Ships against Fire*, 8vo., London, 1785. His nephew republished the work with additions in 1834, stating that "resistance to every possible degree of fire—in warehouses—may be accomplished by applying the fireplates above and below the timbers with dry sand or rubbish between them; in common dwelling houses a single application of the fireplates is sufficient." Rolled copper plates are specified, as well as those of painted iron. Tinned or galvanized iron or zinc would be equally applicable, according to the circumstances of the case. The experiments shewed that the only way to check a fire was to prevent the access of air.

The mode practised by Sir Robert and Sydney Smirke for forming fireproof floors somewhat on the above principle, was to place iron plates of a segmental section, resting on flanges on the sides of iron girders, to carry a thin layer of concrete. Cheyne's patent for a similar principle is noticed *s. v.* FLOOR (FIREPROOF).

HART'S BLACK. That substance remaining in a retort after the spirits, volatile salts and oil, have been extracted from hartshorn, and when properly levigated it answers the purpose of painters nearly as well as ivory black. 6.

HARTWELL (JOHN) has the merit of the general design 1793-1807 of S. Andrew's church, Dublin, the premium of 20

guineas having been awarded to him. It was erected on the old walls not taken down below the sills of the windows. The entrance opposite Church-lane, and the arrangements of the galleries and fittings, are ascribed to F. Johnston, who completed the building after the death of Hartwell about 1800. It was of an elliptic shape; cost £22,000 including the organ; and was burnt 8 Jan. 1860; *DUBLIN BUILDER Journal*, 195.

HARVEY (JOHN) was a pupil of Samuel Wyatt. He exhibited at the Royal Academy, 1785-6 designs for a national prison, and a musical theatre; 1787 a stone bridge over the Menai at Ynys Ymôch, with an arch of 400 ft. span; 1788-90 an observatory, and a front of a parliament house. He designed 1794 the county hall, etc., at Stafford, given in RICHARDSON, *Vitruvius Britannicus*, fol., London, 1802-8, ii, pl. 7-10; the four fronts are built with a freestone from a quarry near Stafford.

HARWICH CEMENT. This cement is obtained, like that of Parker, by the calcination of the nodules of septaria that are picked up on the sea-shore at Harwich, or are dredged up from the bed of the sea in the neighbourhood. Generally speaking the Harwich stone does not yield so good a material as the Sheppey stone; it appears to contain more of the hydrous oxide of iron, while the silicate of alumina is not present in the same proportions; but the difference between the two is hardly perceptible. Great difficulties are now attached to finding the Harwich stone. Both these stones give what is commonly called 'Roman cement'. CALCAREOUS CEMENT. G. R. B.

PASLEY, *Limes*, etc., 8vo., London, 1838, p. 40, says that if 1 measure of calcined Halling lime powder be mixed with 7 or 8 of gravel and sand for concrete, it will require 3 measures of Sheppey or of Harwich cement with the same quantity of gravel or sand, in order to produce a concrete equally sound: this cement is described, pp. 28, etc., of the same work.

HASELBACH (GEORG VON), see GANKOFEN, properly GANKOFER. 68.

HASELBURY QUARRY, situated near Box in Wiltshire, "was most eminent for freestone in the western parts before the discovery of the Portland quarry, which was about 1600. Malmesbury abbey and other Wiltshire religious houses are of Haselbury stone": AUBREY, *Wiltshire*, 4to., Devizes, 1862.

HASP, see HAPSE.

HASSOCK STONE. The sandstone that separates the beds of the Kentish rag is known by the name of hassock and hassock stone, the latter distinction being made when the sand is agglutinated enough to allow its being raised in block. The hassock is a member of the greensand formation, which occurs in considerable quantities about Maidstone; and it constitutes an inferior building stone, used locally for the construction of interior walls and in such positions as are not exposed to the weather.

G. R. B.

It is of a light grey colour; contains a great deal of sand mixed with indurated earthy matter, and lies between the strata of the ragstone in layers of various qualities, some very little better than earth itself. The best is that found between the green and yellow beds of rag, and is sufficiently hard to make a good building stone for internal purposes; it is easily worked, and makes an extremely good lining for ragstone walls, as, unlike them, it never sweats.

| Analysis by Phillips. | | | Ditto by an Exhibitor, 1851 | | |
|-----------------------|---|------|-----------------------------|----|--------------------------------|
| Carbonate of lime | - | 26.2 | ... | 53 | |
| Earthy matter | - | 72 | ... | 4 | Alumina. |
| | | | | 32 | Silica. |
| | | | | 13 | Phosphate of lime, soda, |
| | | | | | (magnesia, and sulphuric acid) |
| Oxide of iron | - | 1.8 | ... | 8 | |

Hassock may be had in London at from 6s. to 7s. "a cord" (3 ft. cube), in roughly squared pieces. It is said to have been used with various other qualities of stone, in the walls of Westminster Hall; and in those of All Saints college, Maidstone. C. H. SMITH, in a communication to the Royal Institute of British Architects, January 1855, notices that Tilburstow Hill,

a mile and a half south of Godstone, supplies good ragstone, while the softest sand rock of the quarry there, may be considered identical with the Hassock of the Kentish rag district; this quarry being twelve miles westerly of the chief quarries of the latter material.

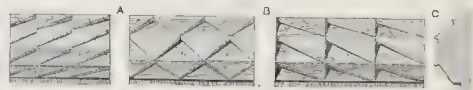
A. A.

HASTA, see ASTA or ASTI, in Piedmont.

HASTLER. An old mode of writing ASHLER, as appears in an unpublished Ely sacrist roll, 13 Edward III. 19.

HATCH. A half-door, called *heck* in Yorkshire; so that a doorway with two hatches is correctly double hatched, although commonly each portion is described as a half-hatch. The hatch properly was grated, and if there was only the bottom division it frequently had iron spikes on the top. In Surrey, a 'hatch' means "a gate in the roads; and a half-hatch is where a horse may pass, but not a cart"; AUBREY, *Nat. Hist. of Surrey*, 8vo., London, 1719, v. 402.

HATCHED ORNAMENT. The name given to ornament, hatched or sawtoothed, which appears in Romanesque



work. The term is illustrated by Fig. A, in KING, *Monimenta Antiqua*, fol., London, 1799-1805, iv, 84; B, in GWILT, *Encyc.*, § 397, and C, from Westminster Hall, in the GLOSSARY, pl. 113.

HATCHET (It. *azza*, *scure*; Sp. *destral*; Ger. *beil*; Fr. *hachette*). A species of axe used by joiners in reducing the edges of a board. It has a broad blade attached to a handle or helve which is about half as long again as the head: if the handle be of iron the tool is called a cleaver; and if the blade be hooked, it becomes a bill (It. *pennato*, *segolo*). A double hatchet (Lat. *bipennis*), seen as a symbol of Jupiter Labrandenus, at Labranda and at Mylassa, is given in FELLOWS, *Asia Minor*, 8vo., London, 2nd edit., 1852, p. 195-277. DOLABRA.

HATCHING. The name given to the operation of drawing a number of lines parallel to one or more main diagonal ones, to represent the solid part of work. The word *etching* is frequently but improperly employed in place of it. HATCHING or MATTING, is explained by HOLME, *Academy*, fol., Chester, 1688, iii, 259, in the following words: "to make a Beast or Lion hairy, a Bird feathers, Fish scales, and Flowers and Leaves, veins and threads". SGRAFFITO.

HAT'EPACE, see HAUT PAS.

HATRA, HATRAB, or ATRAB. A city now called AL HADR, or AL HATHER, in the pashalic of Bagdad in Syria. A stone wall, although ruined, shews the remains of square towers, and encloses a nearly circular space, about a mile in diameter, crossed by a canal from north to south. The dwellings, now also in ruins, were built of stone in two stories of small vaulted rooms connected by narrow flights of steps. At the centre, on the eastern bank of the canal, are the remains of a large building, enclosed by a wall with square bastions and entrances on the line of paved roads from the corresponding gates in the city wall. Its area is stated as about 700 ft. by 800 ft. in FERGUSON, *Illust. Handbook*, 8vo., London, 1855, p. 369, who gives a plan and elevation of the principal portion, supposed by LAYARD to date from about the middle of the third century, which is here noticed on account of the peculiarities of detail in the shape of impostes and archivolts, decorated with leaves of the acanthus, griffins, scrolled foliage, and masks, pronounced to be Roman but worked from memory and not from the instructions of a Roman artist. It may, however, be suggested that they really were rudely executed by native workmen under the direct superintendence of a Greek architect, because the centre of the face of every stone in the walls is occupied by one of a series of marks (a collection was given by AINSWORTH to the Royal Geographical Society, *Journal*, 8vo., London, 1841, xi, 9-19) that are de-

clared by LAYARD to appear on other Sassanian buildings in Persia, and not to be Chaldean letters or numerals. The apartments of this building all open on the east side, without any trace of windows, and have been vaulted under (supposed) flat roofs. They have been described by LAYARD, in a paper read at the Royal Inst. of Brit. Architects 2 Nov. 1846, who notices the walls as being built of a fossiliferous limestone (subject to rapid decomposition), well cut, neatly fitted, and set in a fine cement. This author dissents in some respects from the remarks made by AINSWORTH as above cited, who gives an inscription shewing that the palace was restored 1190; and from Ross, whose plan, etc., are engraved in the Royal Geog. Society's *Journal*, 1839, ix, 467. AINSWORTH, *Travels*, 12mo., London, 1842, ii, 167. LAYARD, *Nineveh*, 8vo., London, 1849, i, 110. 50.

HATRIA, Hadria, Atria, or Adria, in Italy, see ADRIA.

HATTINGA (ANTONY), was a lieutenant-engineer, who practised in Holland about 1779. Conjointly with P. de Swart, he built, 1769-72, the Delft gate at Rotterdam, given in GOETHEBUER, *Choix*, fol., Ghent, 1827, p. 45. 24.

HAUBERAT (. . .), a native of France, arrived at Bonn July 1716, where he was sent by R. de Cotte to conduct his designs for some buildings for the elector, as the palace, the *bonnet retro*, and the church of the archiepiscopal seminary of Cologne, at Bonn; the palace at Brühl; the castle and the chapel at Popelsdorf; and the castle at Gudesberg. The works, etc., at Bonn comprise the gardens, fountains, poultry-yards, tanks for fish, stables, and a spacious dock for the boats and shallops intended for the navigation on the Rhine. De Cotte's designs are given s. n. *Palais de Bonn*, in the CABINET DES ESTAMPES, fol. In 1721 he was nominated superintendent of the buildings to the elector, and a councillor of the finance committee. DUSSIEUX, *Les Artistes Français*, 8vo., Paris, 1851, 36, 38.

HAUDEBOURT (. . .) was born 1788 at Paris. He published *Le Laurentin, Maison de Campagne de Plinè le Jeune*, 8vo., Paris, 1818; and, with SUYS, *Plans, etc., des deux palais Massimi à Rome*, fol., Paris, 1818. NORMAND, *Paris Moderne*, 4to., Paris, 1837-43, gives, i, pl. 11-13, a house in the rue de la Tour des Dames, No. 5; ii, pl. 15, 1820, fountains in the places Royales and S. Georges; pl. 19-20, 1826, the théâtre de Montmartre; and pl. 92-3, 1839, the école primaire supérieure de S. Laurent, as his designs. He sent to the exhibition of 1822 some drawings (*détails*) of the palace Massimi at Rome, for which he received a medal. He died 1849. 110.

HAUPTMANN (JOHANN GOTTLÖB), of Dresden, a pupil of Exner, displayed in many ways his practical knowledge. He was *oberlandbaumeister* at Dresden, where he died in 1813, in the fifty-eighth year of his age. 68.

HAURAN. The great desert track south of Damascus, comprising part of the ancient Trachonitis and Ituræa, the whole of Auranitis, and the northern districts of Batanea, of which Bostra (now Bosra) was anciently the capital. This is partly occupied by the remains of towns, which exhibit the peculiarities of three epochs, viz., of the orders and decorations of Greek art alloyed by oriental fantasies; of Roman art, as at Bostra and Kennaout, continued in its regulated track; and of local spirit indulged in curved architraves resting upon capitals, in buttressed walls, in cupolas on square plans, and in polygonal churches. The notices by SEITZEN, BURCKHARDT, BUCKINGHAM, PORTER, GRAHAM, WETZSTEIN, and REY, were mentioned by DONALDSON at the Royal Inst. Brit. Architects, *Transactions*, 1863-4, p. 121, as well as that by DE VOGÜÉ, published in the *Bulletin de l'Œuvre des Pèlerinages en Terre Sainte*, 8vo., Paris, 1863, iv, who adds an account of the Chalcidic, north of the Hauran properly so called, but sometimes called the Hauran around Aleppo, as containing a series of about one hundred and fifty towns, constructed by Christians between the fourth and seventh centuries.

HAUSER (ELIAS DAVID), of Copenhagen, acquired, in the

first half of the eighteenth century, much renown also as a painter. He was a brigadier, chief engineer, and was living in 1742 with the rank of major-general. He built, in 1733-39, the castle of Christiansborg, which was destroyed by fire in 1794. It was a large and magnificent building, though constructed in the heavy style of that period. A view is given in DE THURAH, *Vitruvius Danicus*, fol., Copen., 1740; and a description in WEINWICH, *Maler-Bildhugger*, etc., *Historie i Danmark og Norge*, 8vo., Copenhagen, 1811. 68.

HAUSER (GEORG; LEONHARD; and GREGOR), were *baumeisters* at S. Stephen's church at Vienna, of whom notices do not agree. Since the publication of the work by TILMEZ, *de Stephansturm*, 1721, it was generally considered that GEORG was the first *baumeister* of the tower; was a clever master at Klosterneuburg; and that he undertook to construct the cathedral (1359). But neither the name of this *baumeister*, of his death, nor of the period during which he was engaged was noticed by TILMEZ. Later researches have shewn that this name of GEORG was only a change from that of GREGOR, who lived one hundred and sixty years later. It was in 1519, when the tower (which had been struck by lightning in 1450, and all its woodwork was consumed) threatened to fall, that two Hausers simultaneously appear. LEONHARD is noticed by CUSPINIANUS, *Austria*, fol., Frankfurt, 1601, p. 66, as *ex valle circo*, a chasseur to the emperor Maximilian, and afterwards a captain in an imperial foot regiment; and GREGOR of Freyburg, as *steinmetz* and *baumeister* at S. Stephen (successor to Georg Khlaig), and both of whom undertook the hazardous enterprise, declined by all others, of rebuilding the top of the spire (which is still perceptibly out of the upright). The most difficult part was to straighten the thick iron spindle bent by lightning. During the time of GREGOR (1516-20), the northern tower was raised to its present height of 25 fathoms. TILMEZ knew that his authorities in favour of the artist who began, and the artist who finished, the building were very doubtful, and therefore concluded, on the authority of the plans in the archives of the city, that, as the MSS. mention A. Pilgram as having finished (1400) the tower, GEORG must have begun it; but it seems that the MSS. were themselves based on erroneous data, because it has been discovered, by FISCHER and others, that the termination of the tower and the placing of the knob took place only in 1433. As to the signatures on the plans attributed by TILMEZ to GEORG, the point was wholly disproved by the signatures themselves, which are merely the initials G. H., and correspond with the period of the reign of the Emperor Maximilian I. (cir. 1519, s. v. Drawing), during which GREGOR was employed. These drawings consist of three ground-plans and three elevations of the tower: the form of the Roman letters reveals unmistakably the end of the fifteenth or the beginning of the sixteenth century. Moreover, they are by no means considered as original. Finally, in the list of the *baumeistern* and *steinmetzen*, there appears only Gregor or Jörg Hauser, whilst the name of Georg is nowhere to be found. 26. 68. 186.

GEORG HAUSER, from about 1505-16, was *baumeister* to the yet unfinished tower of S. Stephen's at Vienna. 92.

HAUT-PAS. This term, corrupted in English to *haute pace*, *halpas*, *halpace*, and *hathpace*, meant what is now called an *estrade*: it thus signified a portion raised higher than the rest of a floor, as in an oriel window, or in front of a fireplace. It is the name of the raised floor called improperly a dais, as well as for a stage or platform. But it has been supposed to have the same meaning as 'foot pace', and as 'half-pace', also corrupted to 'halpace'. 1533, 24 Henry VIII, in records quoted by BAYLEY, *History of the Tower*, fol., London, 1821-5, pt. 1, app. xix. "Hathpace of 14 ft. square" is used by Lord HERBERT of Cherbury, *Pref. Memoir*, cir. 1648. The use of the word 'halpas' will be seen in HOLINSHED, *Chronicles*, 12 Henry VIII, also given in HUNT, *Tudor Arch.*, 4to., London, 1836, 183-5.

HAVANA, or The HAVANNAH, in the Island of Cuba; see CRISTOVAL DE HABANA (SAN).

HAVELBERG. A town in the province of Brandenburg, in Prussia, situated on an island formed by the river Havel, near its confluence with the Elbe. It is built on eight hills, and communicates with the main land by three bridges. The bishopric founded there by king Otto I. (936-73) lasted till 1598. The dom was consecrated 1411, having been then rebuilt; the refectory dates as far back as 1275. This building is the only one of the mediæval constructions of Havelberg, in which the Brandenburg bricks generally employed, were not used; the importance of the edifice seems to have induced the constructors to employ Plötzker stone, the transport of which was rendered easy by the river Elbe. 115.

HAVEN (LAMBERT VON), see HAWEN.

HAVEUS (THEODORE) or Heave, of Cleves, called Haave in DALLAWAY, *Disc.*, 8vo., London, 1833, 354, also a painter and sculptor, is commemorated in the passage dated 1576, "Theodorus Haveus, Clevisensis, artifex egregius, et insignis architecturæ professor, fecit, et insignibus eorum generosorum; qui tum in collegio morabantur, depinxit; et velut monumentum suæ erga collegium benevolentiae eidem dedicavit, etc." A picture of a supposed foreigner, with a polyhedron by his side and a pair of compasses, is said to represent Haveus, to whom has been ascribed Caius court, of Caius and Gonville college, Cambridge, begun about 1566, finished 1573, at a cost of £1,834:4:8; the Wisdom gate, the towers, and the tomb of Dr. Caius, who died 29 July 1573 (which was carved by Haveus and others, at a cost of £47:4:8), cost altogether £175:13:1. Honour gate, built about 1574, costing £128:9:0, was perhaps not by him; it is engraved in the *VETUSTA MONUMENTA*, fol., London, 1747-1842, iii; which also states that HÆVEUS was the name "on the sundial now taken down"; and that the tomb to queen Anne of Cleves, ob. 1557, formerly in Westminster abbey, may be attributed to him; WALPOLE, *Anecdotes*, 8vo., London, edit. 1862, i, 193; IVES, *Select Papers*, 4to., London, 1773. Haveus died in 1566, according to NAGLER, *Lex.*, a mistake perhaps for 1576. The gateways have been often attributed to John of Padua. RICHARDSON, *Observations, etc.*, on *Eliz. Arch.*, 4to., London, 1837, 5, says "I am able to point out—one known example of the peculiar talent and style of the German artist; the Corinthian chimney-piece at Claverton (house, Somersetshire) is known as such by tradition preserved in the family." On p. 18 he gives the date of 1628 for the building of the house; consequently if that decoration be by Haveus it must have come from some older building.

Professor WILLIS, at the Architectural Congress held at Cambridge in 1860, stated that the Honour gate was the earliest instance of classical architecture in stone in England; and that, together with other parts of the college, it was designed by Dr. Caius, who having studied medicine in Italy, had brought home with him Italian tastes. The second court has the peculiar arrangement of the *south side* being left open for ventilation.

HAYLAND (JOHN) was born about 1793 at Taunton in Somersetshire. He studied under J. Elmes, who, while ill, confided the erection of a church at Chichester to his pupil (cir. 1813), who received an extra pecuniary grant. In 1815 he went to Russia to enter the Imperial Corps of Engineers, by invitation from his uncle Count Mordwinoff, then minister of marine to the emperor Alexander; but meeting there the American authorities he was induced the following year to proceed to America, where he erected the Pittsburgh penitentiary, the first designed on the radiating principle; the Eastern penitentiary at Cherry-hill, now the standard for all edifices for similar purposes, and extolled by the commissioners sent from England, France, Russia, and Prussia to examine his prisons; the hall of justice at New York (Egyptian); the United States naval asylum at Norfolk; the New Jersey State penitentiary; the Missouri and

Rhode Island State penitentiary; the jails at Alleghany, Lancaster, Berks, and many others; the deaf and dumb asylum, and United States mint at Philadelphia; the State insane hospital at Harrisburgh; the county halls at Newark and York; and numerous churches and private mansions. He died 28 March 1852, aged fifty-nine years, and was buried in the family vault of S. Andrew's church, Philadelphia. His two sons are members of the American bar. *CIVIL ENGINEER Journal*, xv, 227. Drawings of some of the above named buildings are in the collection of the Royal Institute of British Architects, of which Haviland was an hon. and cor. member.

HÂVRE STONE. The subcretaceous formations that outcrop near Hâvre are used to a considerable extent in the rubble masonry of that town, and for the purpose of obtaining the hydraulic lime there employed; but the term Hâvre stone is more especially reserved for the FIRE STONE, of which a description has been given under that head. The first of these stones is obtained from the upper and lower greensands, and it corresponds exactly with the Kentish rag; it is detached from the cliff of la Hève by the action of the sea. The second is obtained from the chalk marl, that seems to contain a greater proportion of the silicate of alumina than the analogous bed in England; for the lime obtained from it is more decidedly hydraulic, setting as it does under water in four days after slacking. The third is used for similar purposes to that of England, and has the same properties, advantages, and inconveniences. G. R. B.

HAWEN (LAMBERT VON) was born 1630 at Bergen in Norway. He studied at Copenhagen, and was afterwards sent, at the expense of Christian IV, to Rome. On his return, 1670, he was appointed a general *baumeister* and inspector of painting, sculpture (both of which he also practised), and other arts; and designed 1682-95 the church dedicated to the Saviour in the quarter Christianshavn, at Copenhagen, except the spire, added 1749 by L. de Thurah. He died in 1695. 68, 116.

HAWK. The name given to a board about 12 ins. square, having a round handle projecting from the middle of the under side, and by which it is held by the plasterer, who receives on the board the material with which he is to work. The labourer supplying the board with material, is said to 'feed the hawk', and is commonly a youth and called the 'hawk boy'.

HAWKCLIFFE QUARRIES, situated at Steeton, near Keighley, in Yorkshire, supply a very fine grit stone, perfectly uniform in colour, and suitable for architectural purposes: it can be obtained of any size up to ten tons in weight. A coarser kind, from the top bed, is said to be suitable for dock and bridge buildings, engine beds, etc.

HAWKS BELL, see BALL FLOWER.

HAWKSMORE (NICHOLAS), as in 1716, 1736, and in Will 1730; or HAWKSMOOR, as usually printed and as signatures to letters of 1705-11, was born in 1661 at East Drayton, or at Ragenhill or Ragnall, in Nottinghamshire. He became at eighteen (WALPOLE) "the domestic clerk of Sir C. Wren, and was afterwards employed under him at the royal and other public works" (WREN, *Parentalia*, 315); as "supervisor" at the palace at Winchester, begun 23 Mar. 1683 and nearly finished February 1684-5; deputy surveyor at Chelsea college or hospital, 12 March 1682-90; clerk of the works at Greenwich hospital from 1698, and deputy surveyor after 1705 (when he was succeeded by J. James, and in 1736 by Isaac Ware). During this period he conducted the works for completing the west side of the north-west (or Charles) block (from Jones's design); the opposite (or Anne) block 1698-1728; the south-west (or William) block 1698-1703; and the west front of it under Sir J. Vanbrugh, 1726; the colonnades on both sides; and the commencement of the south-east (or Mary) block from 1735 (this block was not completed till 1752). Four original plans of the buildings and locality, for incorporating the queen's house, the erection of a church between that and the hospital, and for an infirmary for two hundred men, dated

1728 and initiated "N. H.", are in the library of the Royal Institute of British Architects; and about sixty others, dating 1727-9, in Sir John Soane's Museum, with a statement of accounts up to Sept. 1727. There are also about fifteen sketches of parts of churches, one having a portico of eight Doric columns, each 60 ft. high. He was also clerk of the works at Kensington palace, in the Board of Works establishment, from 25 Feb. 1690-1 (EVELYN), when king William bought it, to the king's death, 1702, adding that part of the south front containing the king's gallery and the apartments occupied by the late duchess of Kent: he continued in that post, effecting the subsequent alterations before W. Kent's time; left it 4 May 1715, and was appointed clerk of the works at Whitehall, S. James's, and Westminster, at a salary of £90 per annum, succeeding W. Dickenson; from which post he was 'removed' 24 Sept. 1718 for W. Benson, who was also the surveyor; and became secretary to the Board at £100 per ann. He was further appointed, 1726, deputy comptroller under Sir J. Vanbrugh; and June 1735, while still secretary, he was made deputy surveyor; he is afterwards styled 'surveyor general' and 'principal surveyor of his majesty's works'.

Amongst other works (probably under Sir C. Wren's directions), he finished 1713 Easton Neston, Northamptonshire, for William Fermor, Lord Leominster, Wren having built the wings cir. 1680, since pulled down (CAMPBELL, *Vit. Brit.*, fol., London, 1715, i, pl. 98-100): 6 Feb. 1710-1759 completed the first or south quadrangle, with the library and street façade, of Queen's College, Oxford (sometimes attributed to Sir C. Wren, and sometimes to the provost Dr. Lancaster), which is said to resemble the Luxembourg: assisted in conducting the works at S. Paul's cathedral, from near their commencement 21 June 1675 to their completion in 1710 or 11, and perhaps till Wren's removal in 1718: and is said to have assisted his master in the later city churches.

Under Sir John Vanbrugh he was employed as assistant surveyor, 6 June 1705 to the completion 1715, of Blenheim palace, Oxfordshire, built by order of Queen Anne for the duke of Marlborough, £500,000 having been voted by Parliament for it: up to 3 Aug. 1711 he had been paid £800 on account of services and expenses (MS. in Sir John Soane's Museum, in which are drawn plans of the basement and ground floor): and perhaps at Castle Howard, Cumberland, for the earl of Carlisle, built 1702-14 also under Sir J. Vanbrugh; the king's collection in the British Museum has a drawing of the west front of the great cabinet, and a pencil sketch of the plan, together with six sketches, dated 1723, for a belvedere in Wray wood, 25 ft. diameter inside; the mausoleum at Castle Howard was being erected from his design at his death in 1736; DALLAWAY calls this 'the earliest specimen of sepulchral splendour in England unconnected with an ecclesiastical building'; it was published by C. H. TATHAM, and engraved by H. Moses, 4to., London, 1812.

The royal collection also contains a plan, attributed to him and dated 1712, "of the town of Cambridge as it ought to be reformed", adjoining to King's College; and a sketch plan of part of S. John's College, called the labyrinth. In 1713 he directed the operations for screwing up to the perpendicular the north front of the transept of Beverley Minster, which had overhung 4 ft. (two plates of the machinery were published 1739, the carpenter W. Thornton, invt., Ed. Geldart, del.), and other works there; a plate of Beverley, by Vanderghucht after Hawksmore, is dated 1713. He designed 1712-24 the church of S. Anne, Limehouse (consecrated 12 Sept. 1730), at a cost of £38,000, being about 145 ft. long and 78 ft. wide (twenty-three working drawings and sketches are in the British Museum); the interior was burnt 29 March 1850, and was restored 1851-4 by P. Hardwick and — Morris at a cost of £11,000; the seating and painting was done 1857: in 1715-23, consecrated 19 July 1729, the church of S. George Middlesex, formerly called Wapping Stepney and now S. George in the

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East (fifteen drawings are in the British Museum, one dated Aug. 1714); the estimate was £13,570, the cost £18,557 (BRITTON and PUGIN, *Public Buildings*, 8vo., Lond., 1825-8, ii, 94-8; an elevation is given in the GENTLEMAN'S MAGAZINE, 1828, xcvi, pt. 2, p. 297, from measurements by F. Whishaw): in 1716-19, the church for the united parishes of S. Mary Woolnoth and S. Mary Woolchurch, Lombard-street (BRITTON, i, 89-94; and twenty working drawings in the British Museum): in 1720-30, consecrated 28 January 1731, the church of S. George Bloomsbury, in size 110 ft. long, 90 ft. wide, and 50 ft. high (two drawings of a totally different design in the British Museum): and in 1723-9, Christ Church Spitalfields (twenty working drawings and sketches are in the British Museum). He was entrusted with these churches on his appointment 6 Jan. 1716 (with J. James) as first surveyor to the commissioners for building the new churches, Gibbs having resigned. A folio engraving, dated 1721, shews his design for "the cloister joining the library and chapel in the north court" of All Souls college, Oxford, where, with Dr. G. CLARKE, he designed the two towers and the north quadrangle, except the library, being among the first introductions of modern Gothic work. About the same time he made the "grand design" for rebuilding Brasenose college, Oxford (given in WILLIAMS, *Ozonia*, fol., cir. 1733; repeated by SKELTON from the *Oxford Almanack* of 1723; a birdseye view is engraved by G. Vertue). After the death of Wren in 1723 he was appointed surveyor general of Westminster abbey, and continued the building of the two western towers (intended to have had spires 140 ft. high); and completed the works in 1735; W. Dickenson being surveyor until 20 January 1725, when he was succeeded by J. James. He erected, 1724, Panton hall, near Wragby, Lincolnshire, for Edmund Turnor, esq.; additions to which were made by J. Carr. In 1730 he made plans of the old church of S. Giles in the Fields, with others for rebuilding it; these are now in the British Museum, Addit. MS., 15,506; it was subsequently rebuilt by H. Flitcroft. About 1736 he made a design for the Radcliffe library at Oxford (but that by Gibbs was preferred, and was commenced in 1737), the model by Hawksmore is preserved at Ditchley, Oxfordshire. A sketch of a design for a Corinthian altar piece for York cathedral is in the British Museum. He also made a design for a new parliament house "after the thoughts of Sir C. Wren"; and "a noble design for repairing the west end of Westminster abbey", as stated in his memoir.

An engraving was made, 1726, after a drawing by Hawksmore, of the steeple of Bow church, Cheapside; and another of a perspective view shewing a portico at the side in place of the shops. In 1728 was printed an "account of the buildings of Greenwich hospital for the perusal of Parliament by the deputy surveyor, N. H."; extracts are given in WREN, *Parentalia*, fol., Lond., 1750, 328-9. He also published *A short historical account of London Bridge; with a proposition for a new stone bridge at Westminster*, etc., 4to., London, 1736; 3 s.; shewing his design for a bridge of nine arches, of which, says the author, "there is a model in stone". He died at his house in Milbank, Westminster, of gout in the stomach, 25 March 1736, "aged seventy-five", according to the tombstone at the east end of Shenley church, Hertfordshire: the GENTLEMAN'S MAGAZINE erroneously states 19 March. A bust of Hawksmore still exists in the buttery of All Souls college, Oxford.

He was perfectly skilled in the history of architecture, and could give an exact account of all the famous buildings, both ancient and modern, in every part of the world, to which his excellent memory, that never failed him to the very last, greatly contributed. He was a skilful mathematician, geographer, and geometrician, and few excelled him in drawing; according to the memoir by N. Blackerby, his son-in-law, in READ'S *Weekly Journal or British Gazetteer*, No. 603, for March 27, 1736. HISTORICAL REGISTER. v. y.; WALPOLE, *Anecdotes*; GENTLEMAN'S MAGAZINE, vi, 168; CIVIL ENGINEER *Journal*, x, 268-9; BUILDER *Journal*, xx, 562, 590; PENNY

CYCLOPEDIA; CHALMERS, *Gen. Biog. Dict.*, a memoir communicated by his family; and Letters to and from H. Joynes, clerk of the works at Blenheim 1705-15, being Add. MS. 19,607 in the British Museum. His autograph is in the collection of the Royal Institute of British Architects.

HAWNDIRYNE and HAWNDYRNE, see ANDIRON.

HAWTHORN, *Crataegus oxyacantha*, has a hard wood of a whitish colour with a tinge of yellow; the grain is fine; the wood is small and difficult to work, but takes a good polish. The leaves of the hawthorn were sometimes introduced into mediæval sculpture; the south porch of the cathedral at Bourges presents a good specimen, which is said to have been painted a bright green; it is given in the *MAGASIN PITTORESQUE*, 4to., Paris, 1833, i, 172.

HAWTHORNE (HENRY) succeeded Humfrey Michell, clerk of the works at Windsor Castle, who, 27 Nov. 1575, stated to Lord Burghley his past services, and requested to resign his office. Hawthorne was appointed surveyor of the works, having 2s. per day, and designed the gallery now forming part of the library, "a perfect and highly ornamented specimen of the Anglo-Italian architecture"; POYNTER, *Windsor Castle*, fol., London, 1841. In the Record Office are the following papers: 27 November 1575, orders appointed by the earl of Leicester, constable, intrusting the direction of the works to H. Michell, H. Hawthorne, T. Hathe, and W. Jennins. October 1576; ground-plan of improvements and alterations; estimate of the expense of a wall, 10 ft. long, 20 ft. high, and 6 ft. thick, for the terrace. 21 November; H. Michell reports progress of the works during the year, and suggests that Hawthorne should make perfect plans for the gallery and banqueting house; ground-plan of the banqueting house. 10 June 1577, suggests an alteration to be made at the end of the terrace next the college, and that young timber trees be not felled without his consent; plan of the gallery and other alterations by H. H., surveyor of the works. *CALENDAR*, etc. (Domestic series), 8vo., Lond., 1856, p. 506, 529-30, 548.

HAY, Straw, and Moss were formerly, and in some parts of the country are still, used when laying tiles and slates, to assist in keeping out damp and cold, and especially drifting snow. In the fifteenth century the two former were bought to be laid under the slating of S. Peter's church, Oxford: and "1525 For hay to lay under the ledes of the church", occurs in NICHOLS, *Illustrations, etc., of England*, 4to., Lond., 1797, 109. In 1602 a slater charges "for mossing of the great barn and the pker, uppon his owen chardges wee getting the moss, vijs": this applies more especially to the native rough grey stone slates laid on laths and spars, the crevices and joints being stuffed from the outside; *NOTES AND QUERIES Journal*, 3 ser., iv, 28, 59.

HAYA (RODRIGO and MARTIN DE LA), brothers, were also sculptors, and from their style they seem to have been disciples of Becerra. They constructed between 1577 and 1593, the pompous *retable* of the cathedral of Burgos in Spain, consisting of four orders, independently of the crowning work with spiral columns commonly called 'solomonians'; between these upper columns trees were introduced with images of the patriarchs, for the purpose of illustrating the genealogy of Our Saviour. BERMUDEZ, *Diccionario de los Profesores*, etc., 8vo., Madrid, 1800. 66.

HAYDOR QUARRY, near Grantham, Lincolnshire, has been extensively worked to supply stone for Lincoln cathedral; the churches at Boston, Grantham, and Newark; and many in the neighbourhood and in the lower part of Lincolnshire; at Culverthorpe house, Belvoir castle, etc. The stone is composed of carbonate of lime with oolitic grains, often crystalline, and is of a brownish cream colour; blocks are procurable 14 ft. long, 3 ft. wide, and 4 ft. thick; *Report on Building Stones*, 1839, which describes the above named buildings as "of an oolite similar to that at Ancaster".

HAYESSINE. The name of native BORATE OF LIME.

HAY RACK, see STABLE.

HAY ROOM (Lat. *foenile*; It. *fenile*; Sp. *henil*; Fr. *feuil*; Ger. *heuboden*). The place, known as the *tollet* in Herefordshire, in which the hay for a stable is kept in bulk; and in which the corn for the same purpose is usually stored: in stabling, apart from a farm, the straw to be used in the stable is generally also placed there. The space required, beyond that allowed for working machines used in cutting or slicing or crushing, depends upon the quantity of food to be received at once: a load of hay or of straw consists of thirty-six trusses; and a truss of hay is usually cut 36 ins. long, 34 ins. wide, and from 12 to 18 ins. high according to the heat that the stack received. A load of hay can be closely packed; but, owing to the loose nature of the binding etc., a load of straw will require nearly half as much more space. The weight of each truss of hay may be taken at 56 lbs. for old hay, but 60 lbs. for new hay (in June, July, and August); while each truss of straw is supposed to weigh only 36 lbs. Some calculations of the quantity of fodder required for a horse have been given *s. v.* CORNBIN.

The hay room for a stable of twelve work horses on a farm should be on the ground floor, adjoining the stable, and would be best placed under the corn loft: it would probably be the same depth, 18 ft., as the stable from front to back, with a width of 17 ft. The door hangs in a rebated frame so as to open outwards; and is rarely furnished with more than a loose hand bar as fastening. Light is admitted by a fixed sash over shutters to louver-boards. The walls should be plastered. In the corner, that is nearest to the door from the hay room into the stable, may be placed the spout or tube from the corn-loft to the corn-bin, which should be separated by a partition from the hay. Asphalte, or even sand, is recommended as the flooring for the sake of dryness. STEPHENS, *Book of the Farm*, 8vo., Edinburgh, 1851, i, 506.

At small stabling in the country, and generally in a town, the hay room is placed on the first floor over the coach house preferably to the harness room or the stable, if the ceilings of the lower story are not plastered; and it then becomes a *hay loft*. Where the works of a clock pass through the hay loft, provision should be made so that the necessary casing should be easily opened for repairs. A light crane at the loophole door (which should be a hatched door) is a great convenience. No notice is here taken of any means of communication from the hay loft to the stalls, because in new stables hay is rarely put into the rack; where the new system is followed, the rations must be delivered from the loophole into the yard, or from a trap into a passage; but never into the coach house, the harness room, or the stable itself.

HAY'S WATERPROOF GLUE; see GLUE.

HAY TOR, or HEY TOR, GRANITE; see GRANITE.

HAYVET (ABELMIKRAM REJA) designed the mosque of Omar at Jerusalem, erected by the caliph Abd-el-Melik A.D. 688-91, as mentioned by a Mahomedan writer, Medjer-eddeen; whose *History* is translated by VON HAMMER, in *Mines d'Orient*, p. 159, and noticed in WILLIAMS, *Holy City*, 8vo., London, 1849, ii, 419. FERGUSON, *Topography of Jerusalem*, 8vo., London, 1847, and in *Transactions of the Roy. Inst. of Brit. Architects*, 1855-6, p. 109, 109*, states that the building now called the mosque of Omar is the identical church built by the emperor Constantine Monomachus 1048 over the Holy Sepulchre; and that the mosque erected by Abd-el-Melik is the building now known as the mosque of El Aksa. Hayvet was one of the most learned of Mahomedan doctors; was assisted by one Yesid Ibn-Selam, an enfranchised slave of the caliph and a native of Jerusalem, and his two sons; and died in the year 112 of the Hegira, A.D. 730. G. J. W.

HAYWARD (WILLIAM), a native of Shrewsbury, assisted J. Gwynn in the improvements at Oxford, 1771-9; and had designed the stone bridge of five arches at Henley on Thames, eventually erected, but died in 1782, in the forty-second year

of his age, and was buried in the church there; a tablet to his memory is in the south aisle. MILIZIA, *Lives*, edit. Cresy, ii, 388, states that the bridge was designed by Sir R. Taylor. BUILDER *Journal*, xxi, 457. DALLAWAY, *Discourses*, 411, mentions that the heads of Tame and Isis carved on the bridge were the work of the Hon. Mrs. Damer. An elevation of this structure is given in STEIGLITZ, *Plans*, etc., fol., Leipzig, 1800, pl. 83. He also designed the bridge at Tern over the river Tern, sometimes called Attingham bridge, near Shrewsbury, of one arch, 100 ft. span, "erected at the expense of the county 1780, and decorated at the expense of Noel Hill, esq.", as stated in the inscription.

HAZAN (EL MAESTRO) designed and built, 1505, the hospital in the *calle de Toledo* at Madrid, founded, together with the two nunneries of San Geronimo and San Francisco, by Beatriz Galindo; as these were constructed almost at the same period, and as the architecture is much alike, they may both be attributed to him. 66.

HAZE (THÉODORE DE) designed 1688 the church, without aisles, of the Carmelite Friars, in the rue S. Georges, at Bruges.

HAZEL (Latin *corylus*; It. *nocciuolo*; Sp. *avellano*; Fr. *coudre*, *coudrier*, *noisetier*; Ger. *hasel-staude*, *hasel-strauch*). The well known nut-tree, which is not now used as timber, although according to WARBURTON, etc., *Dublin*, 4to., London, 1818, ii, 1013, "the foundations of the old chapel in the castle at Dublin were found to be laid on piles of hazel wood, which in olden times was very plentiful round that city, being the constant companion of oak in the woods of Ireland". The only architectural use of hazel in the present day is for the buildings called *bark-houses*, and for seats in gardens: the branches and stems of this tree, cut to suitable lengths and widths, are nailed in various patterns on the fir framing; and are sometimes mixed with those of the oak, the beech, the mountain-ash, and the spruce-fir: the work is ultimately varnished to preserve the bark and enhance the color.

HAZEL COLOR. This is properly a bright and reddish light brown; thus the term 'hazel mould' is sometimes used instead of 'red loam', although the expression 'dark hazel' sometimes occurs.

HAZON (....) was one of the King's students in the Academy of France at Rome, when he submitted, about 1750, in competition with twenty-seven other artists, a plan for the proposed *place de Louis XV* at Paris, which is described in PATTE, *Monumens*, fol., Paris, 1767, p. 209. He became one of the royal architects, intendant et contrôleur des bâtimens du roi, and was elected 1755 a member of the Academy of Architecture; but as the register of that body does not notice his death, it is inferred that he died after 1790. 45.

HEAD. The classic sculptor seems to have restricted himself for models of heads among the lower creation to the bull, the horse, the ram, the lion, and the dolphin; while the mediæval artist availed himself of real and imaginary creation. The head of the horse is seen in representations of the funeral banquet, where its introduction is assumed to be figurative of death considered as a journey; and occurs in the capitals to the pilasters of the building known as the temple of Mars Ultor at Rome. The horned lion's head appears on a tomb at Persepolis, in the attic over a range of four columns with half bulls that are horned; as shown in TEXIER, *Arménie*, fol., Paris, 1842, ii, pl. 123-5, p. 225, who says, pl. 104 and 108, pp. 218 and 230, with regard to the bicephalic capitals which elsewhere occur in that region, that the question whether a horse or a bull was intended as the capital of the columns in the great hall, and in the harem of Djemschid, is justified by the absence (probably omission) of the horns, but is answered by the fact that the sculptor has expressed the cloven hoof: the details may be compared with the restoration of a similar half bull serving as a cantilever at Chapour, as given in FLANDIN, *Perse Ancienne*, fol., Paris, 1844, whose restoration supplies the horns: the keystone on the arch of Augustus at Rimini

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carries a bull's head. The head of the lion as the gargoyle of a cornice, and the heads of the bull and of the goat, as sacrificial emblems on the works of the sculptors of classic times, are too common to require further notice. ÆGICRANIUM. BUCRANIUM. BULL'S HEAD. DELOS. But it should be noticed that, except in heraldic matters, the mediæval sculptor can hardly be said to have availed himself of the animal head as a means of decoration except in the remarkable ornament called the BIRD'S-HEAD, or cat's head molding, which is one of the most marked ornaments of the richest period of Norman art: this, as seen on the churches of S. Ebbe at Oxford, and at Tickencote, as well as on the cathedral at Lincoln, consists of a series of grotesque heads placed in a hollow, with the tongues or beaks lapping over a large roll molding. Sometimes the tongues or beaks are turned into foliage, as at Lincoln and at Charney; at other times the foliage carries a secondary head, as at Lincoln, where even a third head can be traced. At Charney, however, the human head is the principal feature.

The use of the human head in decoration occurs from a very early period of architectural art: it will be sufficient to name the Isis-headed capital in Egypt; the Bacchic masks in the frieze of the exterior portico to the agora at Aphrodisias; the spandrels to the theatre at the same place; the keystones outside the amphitheatre at Capua; the heads occupying caissons at Baalbec; the corbels of mediæval work, from the rich tower at Castor church, Northamptonshire, to the latest period; and the terminal figures used to carry architraves in modern times. WILKINSON, *Heads placed over Arches*, in the *Transactions* of the Royal Institute of British Architects, 18 May 1863. GORGON; HATRA; KEYSTONE; MEDUSA.

HEAD. The material forming the upper part of an APERTURE is called the head if curved or arched, or the lintel when flat. Brickwork over an opening and packed upon the shewbacks with raking joints but without any radiation, as is seen in bad work, to be afterwards covered with cement, is called a FRENCH ARCH.

HEAD (JERKIN), see JERKIN HEAD.

HEADER (Fr. *boutisse*). The term given to a brick placed with its end to the outside or inside of a wall. The fronts of two houses in Walbrook, cir. 1680, shew all headers; as does also that of No. 32 Grosvenor-square; of No. 181 Bishopsgate-street Without; and of the back lower portion of No. 4, S. James's-square. Such work is now very unusual, and it might be considered to cause the bond of the brickwork to be much reduced in strength; but LANGLEY, *London Prices*, 8vo., Lond., 1750, p. 93, pronounces such work "the most beautiful and the strongest", and suggests two heading half bricks and then a whole heading one, as a cheaper mode where facing bricks are used. The brickwork of many houses at Poole in Dorsetshire is noticed as being built of headers, in NOTES and QUERIES *Journal*, 2 ser., iii, 149. PASLEY, *Outline*, 4to., Chatham, 1826, p. 62, calls this method of constructing a wall 'heading bond', and notices as specimens of it some old buildings at Charterhouse schools, then about to be pulled down; and a house at Frindsbury, near Rochester.

HEADER AND STRETCHER, see FLEMISH BOND; ENGLISH BOND AND BRICK BOND.

HEADING or DRIFTWAY. A small subterranean passage formed in the position of an intended tunnel, from end to end, or from shaft to shaft. In driving it, it is made large enough for a man to conveniently work within it, being about a yard wide by two yards high; and, unless cut in rock, it is strongly lined with planking, so arranged as to have no tendency to come together. It usually occupies but a small portion of the sectional area of the tunnel, in the centre of which it is formed, near the bottom, with a slight ascent inwards, in order that water percolating from the roof and sides may drain outwards to the pumping apparatus. When extended in a straight line from end to end, or from shaft to shaft, it affords the means of setting out the contour of the tunnel at each point, so

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as to secure truthful execution throughout its length, both as to direction and level; besides being a useful channel of communication during the performance of the work. In 1809, many years prior to Sir M. I. Brunel's project of the Thames Tunnel, a driftway, from a shaft, was carried under the river, between Rotherhithe and Limehouse, to the extent of 923 ft., or to within 150 ft. of the opposite shore.

J. W.

HEADING COURSE. The course in a wall where the bricks or stones are laid across the thickness of it so as to shew all headers on the face.

1.

HEADING JOINT. The joint of two or more boards placed together at right angles to the fibres; or in handrailing at right angles to the back or upper side, for the purpose of continuing the length of the board when too short. In good work the heading joints are ploughed and tongued, and in dados they are also secured with glue.

HEADINGTON STONE, see **HEDDINGTON.**

HEADLAND, see **ABUTTAL.**

HEAD OF A CHIMNEY. The upper part of a stack of flues; it generally is ornamented in some way, if only with a blocking course. Ornamented heads are given in *Illustrations*.

A. A.

HEAD OF A DOWN PIPE. A sort of small cistern of iron, lead, or zinc, which receives the water directly from the gutter and conveys it into the stack of down pipes, to which the head is connected by a sort of socket. These heads are square or are molded or ornamented in various ways, and are often semicircular in shape when against a wall, and quadrant-shaped when in an internal angle of a building; in this last case they are called *angle heads*. Where leaves are apt to fall into gutters, or birds to build therein, it frequently happens that the rubbish falls down and stops up the pipe. In this case, it is a very good plan to put a short tube in the head projecting from the outer side like the spouts in a gargoyle, so that the water may flow forward instead of escaping at the joints of the pipes and injuring the wall. These are called 'warning pipes'.

A. A.

HEAD OF A GUTTER. Properly the narrowest part of a gutter; but sometimes a gutter has three heads, one at each end (whether the gutter be parallel or with a sloping side) and a cistern head in the middle: the latter, properly the head of the down pipe, has the prefix of 'cistern' merely to shew that its top is level with the bottom of the gutter; the Fr. *cuvette* is applied whether the head be of lead in the gutter, or of iron on the top of the down pipe outside the wall.

HEAD OF A NAIL. The part struck by the hammer. Heads, according to their form, are called clasp, clout, rose, dog, etc. The heads of brads are called 'bills'.

A. A.

HEAD OF A PARTITION. The horizontal timber into which the studs and struts are framed at top. The term is sometimes applied to the whole truss, which, in good work, forms that part of a partition above the openings.

HEAD OF A PILE (Fr. tête). The upper part of a pile, which is struck when being driven: it is usually round in plan, and confined by an iron ring or hoop, to prevent the material from being split or crushed: the part which unites the round with the square plan of the pile is called the shoulder.

HEADS. A term applied by bricklayers to a tile only a half one in length but of the whole width, laid at the eaves of a roof.

4.

HEADSTONE. An upright stone at the head of a grave to receive an inscription. **STELE.** The employment of the headstone and the footstone in the form prevalent during the last fifty years in England, viz., with either a triangular or a curved top with or without ears or scrolls, does not seem to date much before the year 1600: it is observed in *NOTES AND QUERIES Journal*, 1864, vi, 118, 155, 272, that old cross stones before the sixteenth century are not wonderfully rare; but stones of the sixteenth century do seem rare in our churchyards; while stones of the seventeenth century are not very uncommon; and it mentions some with the dates 1626, 1643, 1656, 1657. In a similar spirit, the *ECCLÉSIOLOGIST Journal*, which, 1842, ii,

60, had given nine sketches as patterns which it approved, observed in 1845, iv, 16, that certain fragments of stone occasionally disinterred in churchyards, and some very few ancient examples yet remaining, lead us to infer that headstones were in use, but much smaller than those now in fashion, and invariably embodying some heraldic form of the cross. Following this hint, several manuals for headstones have appeared, including *BOUTELL, Christian Monuments*, 8vo., Lond., 1849; *CUTTS, Manual of Slabs and Crosses*, 8vo., Lond., 1859; and *TROLLOPE, Manual of Sepulchral Memorials*, 4to., Lond., 1858.

HEADWAY (Fr. échappée). The clear height between the floor and lintel of an opening affording space for a person to go through it without inclining his head. It often means more than this; thus, the 'headway of a stair' should include sufficient space between the step and the soffit over measured perpendicularly, for at least a moderate sized package being carried on the shoulders in addition. In confined localities this requires a very close calculation, as in some instances stairs have been found useless for their purpose, there being no headway, or sufficient height for a person to pass under.

HEALING. The term formerly given (1736) to the covering of the roof of any building, and still applied in Sussex and perhaps other parts of England. To 'heal' a house was to cover the top; and in the west of England a 'healer' or 'hellier' is the workman who covers a house with slates or tiles; *KENNETT, Par. Antig.*, 4to. Lond., 1695, gloss. **HELE; HELOWE WALL; HYLING.**

4.

HEARSE, HERCE, and HERSE (Fr. coulisie). This word originally signified a falling door of grated construction, *i. e.* a **PORTCULLIS**. It was afterwards applied to a sort of horizontal grating, either level or curved, with perpendicular spikes on which to fix the small tapers burnt in honour of the dead, or of a saint; a very well known example exists at the shrine of S. Geneviève at Paris: such apparatus is common on the continent, and is supposed to have received the name of *herse* from the fact that the intersections of the portcullis were often armed with projecting spikes; see *TURNER, Dom. Arch.*, 8vo., Oxford, 1851, i, 101. The name is also given to an open framework of metal covering a sepulchral memorial, as in the case of the monument outside the east end of the church at Braintree, noticed in the *BUILDING NEWS Journal*, 1858, iv, 446, but the appropriateness of the term is better seen when the hearse covers an effigy: the best known example is over the tomb of Earl Richard in the Beauchamp chapel at Warwick, where the hearse is of brass, and composed of six almost semicircular rods, placed at equal intervals across the figure, and sustaining as many bars laid longitudinally. Similar constructions in wood, placed on a bier (Lat. *feretrum*; Ger. *bahre*) to support the pall which covers the coffin, existed at Lenton in Kent, where three biers with hearses, there called 'hoops' (the hearse being literally composed of hoops), are mentioned in the *ECCLÉSIOLOGIST Journal*, 1850, xi, 122: such a hearse (Ger. *fallgatter*) is often seen on the continent, but is frequently triangular in section instead of semicircular.

From the circumstance of the ancient hearse being covered with burning tapers, the funeral decoration sometimes called in France *chapelle ardente* has been named hearse in this country. This construction seems to have been derived from the ordinary bier and hearse covered with lights, and then surmounted by a canopy. From this it became a large structure, hung with tapestries and embroideries, with effigies, arms, banners, cognisances, etc., of the richest description, according to the rank of the deceased, and surrounded with a multitude of lights, while over all hung a rich canopy. As at present on the continent, these were first set up in the house, where the body lay in state, and then in the church before the altar; or, if the funeral procession had some distance to traverse, in any church or other building where the procession rested.

In the royal library at Windsor is a volume containing the designs, by Carlo Fontana, for the hearse or catafalque (1705)

of the Emperor Leopold; in one the incense is burnt in thuribles in form of cannons, the smoke issuing from the muzzles. A singular effect was produced at the funeral of the Princess Borgia at S. Maria Maggiore at Rome a few years ago; the canopy consisting only of an immense pall suspended over the hearse by thin wires painted black so as to be invisible, and to give the idea that the pall floated in the air.

A. A.

The documents concerning the expenses and details of the wax hearses made by Roger Elys, chandler (1395), for the funeral of Anne, wife of Richard II, given in Gough, *Sep. Mon.*, fol., London, 1796, i, 167, shew that the hearse or canopy was in fact a complete architectural composition, with tabernacles, images, etc., complete, but cast or modelled in wax: these details have not been forgotten by WILLIS, *Arch. Nomenc.*, 4to., Camb., 1843, p. 74. Of a somewhat later date are the notices in Devon, *Issues of the Exchequer*, 8vo., Lond., 1837; as p. 326, the sum of £200 for a hearse made at Canterbury by Simon Prentot, chandler, 1413-4, for the obsequies of Henry IV; p. 376, the sum of £310: 1: 6 for divers hearses, 1422-3, for the funeral of Henry V; and p. 427, the sum of £41: 13: 4 for a hearse made at Westminster by John Davy, chandler, 1435-6, for the funeral of the Duke of Bedford, and of £5 for renewing the same hearse for the funeral of Queen Anne of France. In 1509, at the funeral of Henry VII, the body was "taken out of the chamber where he died, into the great chamber, where it rested three days, from thence into the hall, where it was also three days, and so three days in the chapel, and in every of these three places was a hearse of wax garnished with banners: it was then conveyed to S. Paul's and set under a goodly herse of wax garnished with banners, penoncelles, and cushions, and next day was carried to Westminster, where there was a curious herse made of nine principals full of lights": according to HALL, *Chronicle*, s. a. The bier used on this occasion is called a 'chair' by SANDFORD, *Geneal. Hist.*, fol., London, 1707, p. 472, in which work, pp. 720 and 755, the biers for the funerals, 1694, of Mary II and, 1701, of William III, are called open chariots: the same author, p. 492, calls that used 1546-7 for the funeral of Henry VIII a stately chariot; and notices that "a sumptuous hearse of Virgins-Wax was prepared within the chapel at Whitehall, with six goodly pillars, weighing by Estimation 2,000 pounds, under which herse was a canopy of rich cloth of gold": the hearse at Windsor was similar, but with thirteen pillars, and weighed 4,000 pounds. In that volume, p. 561, will be found a print of the hearse or mausoleum erected in Westminster Abbey, 1625, for the funeral of James I.; and, p. 721, another of that, 1695, for the funeral of Mary, wife of William III. The SOCIETY OF ANTIQUARIES, *Vetusta Monumenta*, fol., London, 1815, iv, pl. 16-20, give a representation of the hearse in Westminster Abbey, 1532, for the funeral of Abbot John Islip; and the contemporary account states that the "herse wt all thother things did remayne there still untill the monthes minde". And in the same work, 1796, iii, 17-24, is a facsimile of the Addit. MS. 5408 in the British Museum, shewing the funeral procession, 1603, where the body of Elizabeth is carried on a 'charrett' under a canopy. It will thus appear that the hearse of the present day is by no means the mediæval hearse, but rather that of a time posterior to the Reformation. And this is evidenced by the Harl. MS. 2129, fo. 37-58, which gives designs for tents as hearses for persons of every rank (including those executed 1580 for the funeral of Robert Horne, Bishop of Winchester, and 1591 for the funeral of Lord Chancellor Sir Christopher Hatton, which are tents with open sides, i. e. canopies, the precursors of those shewn in SANDFORD, pp. 561 and 721); but in the account, p. 59, of the funeral, 1658, of Oliver Cromwell, the 'hearse' evidently means a bier (without a canopy), where the word is probably used in the sense of a grated hand-barrow. In the *ARCHÆOLOGIA*, 1812, i, 282, is the decision, 1569, as to the property in the *herstes* used in Westminster Abbey. The It. and Sp. *catafalco* properly meaning a scaffold or stage, but extended to the general

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decoration of the building in which the ceremonies occur, as shewn in some of the plates representing the funerals of several members of the royal family in France by Jean BÉGIN, *Recueil de Mausolées*, fol., Paris, 1687-1714; Fr. *catafalque*; Ger. *kata-falk*, *leichengerüst*, *trauergerüst*, was the legitimate descendant of the mediæval herse, and upon such a subject the talents of the most eminent artists have been employed; this was the case with that used for the obsequies of M. A. Buonarroti in Florence as described by VASARI; and with the catafalque for the funeral of Maria, the first wife of Charles II of Spain, executed from the design of Churriguerra, as shewn in VERA Y TASSIS, *Noticias*, fol., Madrid, 1690. A *castrum-doloris*, as modern Latinists call it, as that designed 1740 by J. E. Fischers on the death of Charles VI, is a real hearse, and is not to be confounded with such a hearse as the ship car of the funeral of Charles Albert used at Genoa; or the bier of the funeral of the Duke of Wellington in London, both given in the *ILLUSTRATED LONDON NEWS Journal*, 1849, xv, 277; 1852, xxi, 440; or the car of the procession of the remains of Napoleon I. in 1840 to the church of the Invalides.

HEART BOND. That construction of walling in which two stones side by side form the width of the wall, and a third stone of an equal breadth is put over the joint in the course above. DIATONOS.

1. 2.



In brickwork it is the heading courses in two brick walls, in the middle of the wall, without which the work is nothing but two one-brick walls put side by side without anything to tie them together, or to prevent their bulging.

A. A.

HEARTH (Lat. *foculus*; It. *focolare*; Sp. *fogon*; Fr. *foyer*, the front hearth; *âtre*, the back hearth; Ger. *herd*). The place where wood was burned in the Mediæval period, when the fire was made in the middle of the hall. When coal is burned in stoves, or more properly grates, the hearth is generally considered as divided into two parts; the front hearth or SLAB, and the back hearth. The former projects beyond the chimney breast into the room, and is usually carried either on a brick 'fender' if in a basement or room on the ground, or on a 'cushion trimmer' if any room be beneath it. Front hearths or slabs formerly were of polished marble, but as they are now generally covered with rugs, and consequently not seen, they are more usually of Portland, or of rubbed York, stone. Marble hearths are, however, still put in houses of the best class. Tile hearths with stone or marble rims or fenders, have been largely introduced of late years. Back hearths, which are within the chimney opening and under the grate itself, are generally of York stone, and occasionally of cast or of sheet iron plates. The rules for methods of support, materials, and dimensions, are stated in the (1855) Metropolitan Building Act, 18 and 19 Vict., c. 122, sec. xx; and also II, 12, 13, and 17. BRICK FENDER, and BRICK TRIMMER; IGNITION; TRIMMER.

A. A.

The hearth stone in good work has a wood border on three sides forming its junction with the floor, and this border should be mitred at the angles; in common work, however, the border is usually dispensed with, and the boards run up to the stone.

J. Tod, secretary to the Royal Scottish Society of Arts, called attention 24 March 1845 to the number of fires occurring from the overheating of the hearth setting fire to timber joists placed under it, in consequence of the introduction of the low Kin-naird grates; and recommended for old houses that an iron ash-pan should be used, raised about an inch, to allow a current of air to pass between the pan and the stone; *CIVIL ENGINEER Journal*, viii, 157. The Building Act, 1855, requires that no timber be placed within 18 ins. of the upper surface of the hearth; and though such an injunction had been previously in force for about seventy years, the neglect of the provision is still a matter of constant occurrence, especially with speculative builders. A very bad practice in the country is to put boards instead of a brick arch trimmer, and to form the

hearth on them in cement. Jennings' patent arrangement of hearths, using a cast iron trimmer in lieu of one of timber, is shewn in *BUILDER Journal*, 1858, xvi, 371; and Edwards and Co.'s patent ventilating hearth plate, for the supply of air to the fireplace, is described in the same *Journal*, xviii, 535.

In a smithery the hearth is the fireplace of the forge; *PASLEY, Outline*, 4to., Chatham, 1826, p. 216-7, states that the hood over the hearth was abolished at H.M. Dockyard by the invention of Mr. Perkins, who, taking his idea from the Staffordshire grates, made a square opening in the back about one foot above the hearth, through which the flames and smoke will pass into the flue: this method is in use in the patented hearth fires of J. Leslie.

HEARTH STONE. A soft description of sandstone with a calcareous cement, found at Reigate, or at Godstone in Surrey, and anywhere in the outcrop of the upper green sand, as at Folkestone, Havre, etc. It was called 'hearth stone' on account of its being especially appropriated of late years for the hearths and coverings of fireplaces; for which purpose the stone was well adapted, on account of its resistance to the effects of heat, from the presence of a great proportion of silica in its composition. This use of the stone has very much gone out of fashion since the introduction of fire-bricks and lumps. The Reigate stone, or some other precisely analogous to it, as *GATTON STONE*, was much employed in mediæval buildings for rough ashlar. The composition now commonly known by the name of 'hearth stone', and used to whiten internal paving, staircases, etc., is made of powdered hearth stone mixed with a proportion of pipeclay.

C. R. B.

HEARTING. The filling in of a wall with inferior material where the outside casings are of squared stone, or material of more costly description. This, which is often the case both in old Roman and in Mediæval work, has been the cause, when badly executed, of failure in many structures. If the hearting be of rubble stone, there should be bond courses every two or three feet to bring the whole to a level bed, and always a sufficient number of bond or through stones. When well built and set in good mortar, the hearting of a wall is still found existing, in Roman as well as in Mediæval work, in a sound state long after the facing has been destroyed. *DIAMICTON*; *DIA-TONOS*; *EMPLECTON*.

A. A.

HEART MONUMENT. A description of a tomb, enclosing a heart only (which, dating about 1307-27, in Ewyas Harold church, Herefordshire, was opened in 1861), is given in the *BUILDER Journal*, xix, 822-3.

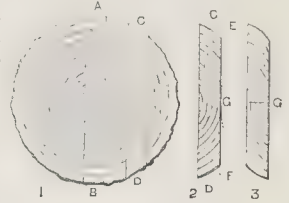
HEART WOOD. A transverse section of timber commonly used for framing purposes, shows rings around the centre or pith, which rings have an exterior covering of several thinner layers commonly called the bark; the lines proceeding from the pith to the bark are the medullary plates or rays. The crude sap rises through the external layers of the wood to the leaves; and, returning through the bark, combines with that in the external layers of the wood, the two constituting the *cambium*: the latter, consolidating, produces a new ring; and the bark also receives a similar minute addition. The circulation of the sap is thus limited to a few of the external layers, being those of the sap wood or *alburnum*; which are in a less matured state than the perfect wood or *duramen* behind it: about an average number of layers exist as sap wood in the pieces of a tree, whether at two years old or twenty. The last act of the circulation as regards the heart wood is the deposition of the colouring matter, resin, or gum, through the agency of the medullary rays, which leave the contents in the layer outside the true wood: it is supposed that as one layer is added each year, so one is perfected annually and thrown out of the circulatory system; the connection between it and the bark has become broken, which is evinced in numbers of trees that are seen in vigorous growth within the bark, whereas at the heart they are decayed and rotten. *TIMBER*; *WOOD*.

H.

The 'duramen' is the hardest, soundest, and most durable

portion of the 'stuff'. The term 'heart' is also applied by joiners to that part of a board which is nearest the centre of the tree and furthest from the sap. In superior joinery the treatment of the heart of the wood is of great consequence in preventing work from warping or twisting; the cause will be clear from the diagrams, though in general but little understood. Fig. 1 is the section of a tree, the circles shewing the layers or deposits of wood

as the trunk grows and increases in size. It will be seen that a board cut across the heart, as at A B, will have all its layers or grain parallel and at right angles to the face of the board. There will therefore be no reason for the board warping; and it



will readily be understood why the best work should be made of stuff cut right across the heart of a stick of timber. But as a whole tree cannot be sacrificed for a single board, some must be cut as at C D. Instead, then, of the layers being horizontal to each other, or at right angles to the face of the board, as in A B, they are all portions of circles, and assume the form as in fig. 2. While the tree is whole, these circles are all in a state of tension, clasping the trunk of the tree, as it were, but as soon as they are cut across by the saw this tension is released; and by their natural elasticity the board is forced back to the dotted curved lines *EF*, and is the cause of the 'warping' of the board. To counteract this, the best joiners formerly ripped down the stuff at *C*, and reversed the pieces end for end, making a glue joint in the middle so that the strain was in different directions, as in fig. 3, and the tendency to warp was compensated. It was in this way the very wide panels of wainscoting in old houses of from one hundred to two hundred years ago were framed; in which it is rare to find a panel split or a glued joint opened. Besides assisting in counteracting the tendency above described, glue will connect wood more soundly if the latter be applied heart to heart, or sap to sap. This maxim, if possible, should always be attended to in all gluing up. In framing, as doors, etc., the stuff should always be "turned inside out"; that is to say, the stiles should be so framed that the heart wood is outside or next the jambs, and the sap wood inside or next the panels. By sap wood, absolute sap or 'blue border' of course is not meant; this should in all cases of even moderately good work be ripped off and rejected. *HOLTZAPFEL, Woods*, etc., 8vo., London, 1843, p. 51. *ALBUMEN*; *ALBURNUM*; *COLTIE*; *DRY ROT*.

A. A.

HEARTY STUFF. Trees and sticks of squared timber which have a very large proportion of 'duramen' to that of 'albumen' are thus called. They are generally trees of slow growth.

A. A.

HEAT. A substance, or an accident, according to the views taken by the two schools into which the world of science is divided in the consideration of an imponderable ether universally diffused. These views are known as the theory of emission; and the theory of vibration: by the first, heat is assumed to be provided as an antagonist to cohesion, being an atmosphere that is given to every molecule, is repellent of the similar envelope of other molecules, and is capable of passing from one body to another: by the second, heat is assumed to be a form of motion, being the oscillation given by the movement of the material particles of any body to the ether which conveys such motion with great velocity. At present the best explanation of the various phenomena relating to heat is supposed to be provided by the latter theory, which suggests that heat and sound are respectively produced by movements of ether and air.

Whichever view be adopted, it is acknowledged that the general action of heat upon bodies is the development of a repulsive force continually antagonistic to molecular attraction,

as in fusing and boiling; that although bodies expand by the action of heat, some do not return to their former volume when they resume their previous temperature, as in the cases of plates of glass, lead, and zinc; that steel does not expand, after a high point of temperature has been gained to the extent that might be expected; that water contracts in cooling down to 4° centigrade or 39° Fahrenheit, and expands in further cooling to 0° cent. or 32° Fahr., assumed to be due to a peculiar arrangement taken by its particles preparatory to crystallization; and that the slow rate at which glass receives the propagation of heat causes very unequal expansions and consequent fractures.

Both schools adopt principles analogous to those, on which the undulatory theory of light is founded, and teach, that radiation takes place in all directions round a body, in a right line or in refracted rays, in a vacuum as well as in air, in the same manner and with four-fifths the same velocity as light; that the intensity of radiant heat (or the quantity of heat received on any unit of surface) is proportionate to the temperature of the source, inversely as the square of the distance, and lessening, in the same proportion as the sine of the angle of emanation, according to the obliquity of the rays with regard to the radiating surface: that as all bodies, whatever be their temperature, constantly radiate heat in all directions, there must be a mobile equilibrium of temperature; *i. e.*, when two adjacent bodies attain the same temperature, heat is still exchanged between them: that the heat which produces a sensation of warmth to a person standing near a fire, is not transmitted by the intervening air, but passes through it without raising its temperature (as is also the case with heat in passing through a vacuum, or through water which is flowing with such rapidity as not to become heated, or through a lens of ice which is not melted though used to inflame wood): and that such substances as sawdust, shavings, or straw, between whose particles air remains stationary, offer great resistance to the propagation of heat; for this reason ice is packed in bran or flannel, and water pipes in matting or straw.

As much difficulty in the comprehension of various theories of heat arises from a careless use of the terms employed, it is desirable to give the following explanations. Heat transmitted through a solid body is said to be *conducted*, and this movement is called *propagation by contact*. Heat passing through the air is called *radiated heat*, and is held not to alter the temperature of the intervening medium. The *radiating or emissive power* of a body is its capability of emitting a quantity of heat greater or less than a given standard at the same temperature and with the same extent of surface—and the law has been found that rough surfaces allow heat to pass out more freely than those which are smooth or polished. When rays of heat fall upon a body, this *incident heat* is divided into three parts, one being reflected irregularly in all directions and called *diffused heat*; another being *reflected* regularly, and the other *absorbed*. The *reflective power* of a substance is its property of throwing off a quantity of incident heat greater or less than a given standard. The *absorbing power* of a body is held to be the same as the power of radiation; and is always inversely as its reflecting power, so that a good conductor is a bad reflector. The absolute absorbing power, or the ratio of the quantity of heat absorbed to that received, varies with the inclination of the incident rays. The alteration of size of substances by *contraction and expansion*, has been considered *s. v.* DILATATION and EXPANSION. Expansion is of course cubical; it is usual to estimate the lineal dilatation, and to consider the superficial and the cubical dilatation as respectively the double and treble of that quantity. In proportion as a body absorbs heat, the repulsive force between the molecules is increased, and ultimately a point is reached, at which the molecular attraction is not sufficient to retain the body in the solid state, dispersion of the particles occurs, and *fusion* takes place; while substances like wool, paper and wood, do not fuse but decompose.

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Ice at 33° in melting to water of 40° receives 139° of heat; this great quantity of heat, or matter of heat, produces no other effect than fluidity; the water is never more than 8° warmer than the ice; and therefore the heat appears to be absorbed within the water, and is called *latent heat*; it is not discoverable by the application of the thermometer. There is besides, the *latent heat of evaporation*, also not indicated by the thermometer, being the superabundant amount absorbed during ebullition and thrown off.

BAKER, *Chemistry of Common Things* (Heat) in FREEMASON'S MONTHLY MAGAZINE, etc., 8vo. London, 1858, p. 436, *et seq.*, gives, p. 1210, the following list; the remarks made, *s. v.* FUSIBILITY in this Dictionary, with regard to the pyrometer, should be noticed.

| Degrees | Effects—Cold and Heat | Authority. |
|---------|--|------------|
| 90 | Greatest artificial cold produced by - - - | Walker |
| 55 | Nitric acid freezes - - - | Cavendish |
| 50 | Natural cold observed at Hudson's Bay - - - | - |
| 46 | Sulphuric ether freezes - - - | - |
| 39 | Mercury freezes - - - | Cavendish |
| 0 | Zero, temperature of equal parts of snow and salt | Fahrenheit |
| 0 | Zero, proof spirits freeze - - - | Wedgwood |
| 20 | Wine freezes - - - | - |
| 30 | Milk freezes - - - | - |
| 43 | Phosphorus burns slowly - - - | - |
| 50 | Medium temperature of the globe - - - | - |
| 59 | Vinous fermentation commences - - - | - |
| 66 | Animal putrefaction begins - - - | - |
| 77 | Summer heat - - - | - |
| 77 | Vinous fermentation rapid—Acetous begins - - - | - |
| 80 | Phosphorus burns in oxygen - - - | - |
| 88 | Acetification ceases - - - | - |
| 92 | Tallow melts - - - | - |
| 96 | Ether boils - - - | - |
| 98 | Animal temperature - - - | - |
| 107 | Fever heat - - - | - |
| 112 | Spermaceti melts - - - | Bostock |
| 122 | Phosphorus inflames - - - | Fourcroy |
| 142 | Bees' wax melts - - - | - |
| 150 | Albumen coagulates - - - | Black |
| 174 | Alcohol boils - - - | Black |
| 212 | Water boils - - - | - |
| 218 | Sulphur melts - - - | Thomson |
| 303 | Sulphur burns slowly - - - | - |
| 303 | Camphor melts - - - | - |
| 412 | Tin melts - - - | Crichton |
| 460 | Surface of polished steel acquires a pale straw colour - - - | - |
| 476 | Bismuth melts - - - | Irvine |
| 580 | Surface of polished steel acquires a deep blue colour - - - | - |
| 612 | Lead melts - - - | Crichton |
| 635 | Lowest temperature of ignition of iron in the dark - - - | - |
| 690 | Mercury boils - - - | Dalton |
| 680 | Zinc melts - - - | Davy |
| 732 | Iron bright red in the dark - - - | - |
| 790 | Heat of a common fire - - - | Irvine |
| 802 | Charcoal burns - - - | Thomson |
| 809 | Antimony melts - - - | - |
| 1,000 | (800° according to some) Hydrogen burns - - - | Thomson |
| 1,277 | Iron red in daylight - - - | Wedgwood |
| 2,372 | Iron begins to soften—white heat - - - | - |
| 2,837 | Diamond burns - - - | Mackenzie |
| 3,807 | Brass melts - - - | Wedgwood |
| 4,717 | Silver melts - - - | Wedgwood |
| 4,587 | Copper melts - - - | - |
| 5,237 | Gold melts - - - | Wedgwood |
| 8,487 | Working heat of plate glass - - - | - |
| 10,177 | Heat of flint glass furnace - - - | - |
| 11,300 | Welding heat of iron - - - | Wedgwood |
| 17,327 | Heat of smith's forge - - - | - |
| 20,677 | Nickel melts - - - | - |
| 21,637 | Iron melts - - - | - |
| 21,877 | Manganese melts - - - | - |
| 20,597 | Hessian crucible melts - - - | - |
| 23,177 | (According to some 11,454) Platinum melts - - - | - |
| 25,127 | Greatest heat observed - - - | - |

To measure the quantity of heat gained or lost by a body, it has to be compared with a standard; in England a pound of water is taken as unity and called a *calorie*, the formula being the weight in pounds, multiplied by the specific heat, and then by its temperature. *Obscure heat* is the name given under a distinct hypothesis to heat from the sun's rays which penetrate the atmosphere without apparent absorption, but which, on meeting the earth and warming it, are supposed to undergo a change in their quality, and having become *obscure*, no longer possess the power of penetrating the atmosphere, but are absorbed; *e. g.* the heat of the sun passes through glass, but by

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contact with anything it becomes changed into obscure heat, which cannot retrace the glass. With regard to the chemical agency of heat it must suffice here to notice, that at common temperatures lead and tin are but little affected by oxygen, and copper by sulphur, but that it is by heat that the oxides of these metals are easily procured. In the passage of steam through an iron pipe, the metal at a high temperature takes its oxygen and evolves the hydrogen. **ATMOSPHERIC INFLUENCE.** In the *Civil Engineer Journal*, 1847, x, 191, are notes on the advantages of forcing heated air into the boiler of a steam-engine; and 193, on the application of heated currents to manufacturing and other purposes. The permanent distribution of heat, and the laws of cooling in bodies warmed from any sources, and bounded by any surfaces, are discussed by **FOURIER**, *Théorie Analytique de Chaleur*, 4to., Paris, 1822, and subsequent essays; and by **POISSON**, *Théorie Mathématique de la Chaleur*, 4to., Paris, 1835, with a supplement, 1837; **PESCHEL**, *Elements of Physics*, translated by **WEST**, 12mo., London, 1846, ii, 143-265. **GANOT**, *Elementary Treatise on Physics*, translated by **ATKINSON**, 8vo., London, 1863, pp. 189-344, discusses the nature of mechanical heat produced by friction, percussion, and pressure; physical heat, such as terrestrial heat, solar radiation, molecular phenomena such as absorption, liquefaction, and solidification; electrical heat; and chemical heat, from eremacausis to actual ignition, which do not come within the limits of this article; but some peculiarities will be noticed *s. v.*, **IGNITION** and **SPONTANEOUS COMBUSTION**.

HEATHER ROOFING, see **THATCH**.

HEATH STONE. A name given by builders to a description of sandstone that occurs in irregular masses in the Bagshot sands, a superficial and local deposit, overlying the London clay formation; it is both geologically and lithologically the precise analogue of the *grès* that is found at Fontainebleau, the Forest of St. Germain, etc., in France. The stone is composed of irregular crystals of quartz, like sand, in fact, connected together with a siliceous, or occasionally a calcareous cement; it is very hard and irregular in its fracture, but is capable of being dressed with the hammer in the same way as granite.

G. R. B.

It was employed at Windsor Castle during the Mediaeval period, thus "Heath stone from Cranbourne Chase," was used at S. George's chapel, 1476, 18 Edw. IV.; **TICHE** and **DAVIS**, *Annals of Windsor*, 8vo., London, 1838, i, 375: and for paving the town of Windsor. In modern times it was used by **James Wyatt**; by **Sir Jeffrey Wyatville**; and by **A. Salvin**, with Bath stone dressings, at the new guard room; **BUILDER Journal**, xx, 302. Another heath stone obtained at Hitchendon or Hughenden heath, near Wycombe, was used in the ecclesiastical houses near the 'hundred steps,' in 1861, with alternate rows of flint intermixed. When used in the facing of walls it is in nearly square hammer-dressed blocks, the joints sometimes gargetted, *i. e.* with flints stuck in them, the appearance being that of Kentish rag, but in much deeper courses.

HEATING APPARATUS. The general history of the means of obtaining artificial heat in apartments is given in the *Detached Essay*, **HEAT**, 1851, with a list of the chief publications on the subject, to which any additions will be found *s. v.* **WARMING APPARATUS**.

HEAVE, see **HAVEUS (THEODORE)**.

HEB, HEBE, HEBI, HIDE, and IBIS. A town now represented by El Khargeh, situated in the Great Oasis of the same name in Upper Egypt. The principal temple, erected about six miles north of the metropolis, was probably dedicated to Ammon-ra, and was built in the reign of Darius Hystaspes (b.c. 521-485), whose name it exhibits; it is about 142 ft. long, 63 ft. broad, and 30 ft. high, and was added to by **Euergetes I** (b.c. 247); the material is red sandstone. Several views of this temple, with those of the necropolis of about one hundred and fifty regularly arranged tombs of crude brick, of the large

chapel, with other ruins at least as late as the reigns of Hadrian and of Antoninus Pius (A.D. 117-160), are given in **HOSKINS**, *Visit to the Great Oasis*, 8vo., London, 1837, p. 71-132. 28.

HEBALSOO. A yellowish coloured wood of Canara, yielding beams 2 ft. square and 20 ft. long—used in house building. 71.

HEBREW ARCHITECTURE. The Jews would seem to have invented no national or special style; for however peculiar were the arrangements of their temple, their tombs, and their pools, the very scanty ornamented details which are still found existing of any of their buildings or excavations, are borrowed from the styles of the nations with whom they had most intercourse at the several periods of their history; a fact borne out by the description of their buildings given in the Bible and in **JOSEPHUS**. And what is more remarkable, the foreign architect employed on their largest construction, Solomon's temple, came from Tyre, a district which affords no remains of monuments but those of borrowed styles. Thus it may be presumed that until the time of Solomon the small amount of art of any kind which existed among the Jews must have been derived from Egypt; and that under this influence was carried out the arrangement and ornamentation of the tabernacle, by the direction of the architects chosen by Moses (with the universal approbation of the people), viz. **Besaleel**, son of Uri of Judah, and Moses' grand-nephew, and **Aholiab**, son of Ahisamach of Dan. **JOSEPHUS** describes the ornamental patterns employed as lilies and pomegranates (*Antiquities*, iii, vi, 7).

The remains of monuments of the period preceding that of Solomon are very scarce and doubtful in Palestine itself. **PIEROTTI**, *Jerusalem Explored*, 4to., London, 1864, in his recent researches, believes that some portion of the ancient wall near Rachel's tomb must have belonged to the village of Zelzah, mentioned in 1 Samuel, x, 2. This conjecture, if correct, only affords a very rude specimen of masonry without mortar or cement. The tombs of Rachel and of Samuel, at a few miles distance from Jerusalem, at Samweel and on the Bethlehem road, as far as they have been explored by the above named writer, only display in their most ancient part a plain sepulchral chamber carved out of the rock. The tomb of Absalom in the valley of Jehosaphat, which has so evident a late Roman appearance, may be the original monument raised by Absalom, modernized by Herod as far as the lower and upper part is concerned; while the cornice dividing them may, from its weather-beaten appearance, have been the main ornamental feature of the original monument. It is completely Egyptian in character; as are also the cornices of the adjoining tomb of Zachariah, and of a tomb close to it, at the point where the village of Siloam begins, and which has no other and subsequent ornamental feature carved out of its rocky mass. These three last tombs contain a sepulchral chamber within a block of rock of cubic form, isolated from its adjoining cliff, so as to give it the appearance of a building.

The sepulchral chambers cut in the rock in the valleys about Jerusalem, and in other parts of Palestine, are innumerable; and as some of them belong to the ante-Solomonian period, the following general description of them may be at once given. "A door in the perpendicular face of the rock, usually small (and low) and without ornament, leads to one or more small chambers excavated from the rock, and commonly upon the same level with the door—and the walls in general are plainly hewn, and there are occasionally niches or *loculi*, or resting places for corpses"; **ROBINSON**, *Biblical Researches*, 8vo., London, 1856, i, 352. In some cases these *loculi* are made so that the dead lay at right angles to the side of the chamber in an oven-like or oblong *loculus*; at other times, and most likely in the more primitive, they were laid in a shallow *loculus* parallel to the chamber wall. The Holy Sepulchre of our Lord consisted of a small rock-hewn sepulchral chamber of this kind with a single shallow *loculus* in it, wherein the sacred body of our

Lord was laid as if on a recessed couch. A small vestibule generally exists between an outer and an inner entrance. Some rock-hewn tombs contain several chambers placed on various levels, and contain *loculi* for as many as nearly a hundred corpses.

The characteristics of the temple of Solomon, and of the palaces built by him, are known only from description; and the reader is referred to the accounts given by FERGUSON, *Handbook of Architecture*, 8vo., London, 1854, i, 201, in which he very ingeniously compares the arrangement of the innermost part of the temple to the temple-palace of Darius at Persepolis; while the description of the house of the forest of Lebanon by JOSEPHUS still more distinctly resembles that of an Assyrian palace. It may be presumed that Hiram, the Tyrian architect sent for by Solomon, introduced among the Jews the style of Assyrian architecture. This Assyrian fashion must have lasted certainly until the Greek invasion of Syria and Egypt under Alexander the Great, B.C. 332. There is no precise indication in JOSEPHUS of Egyptian art resuming its sway in Palestine under the suzerainty which the Ptolemies exercised over the Jewish nation. The only record of any Egyptian work of art being introduced during that period in Jerusalem, is found in the elaborate description of the table of gold and two cisterns of the same metal sent by Ptolemy Philadelphus to the temple of the Jews; JOSEPHUS, *Antiq.*, xii, 2, 9. That Greek architecture, however, must have prevailed at that period, may be conjectured from what remains of the temple of the Samaritans on Mount Gerizim, which displays an oblong enclosure about 500 ft. long, and still about 15 ft. high in some places, fortified by square towers or *ezedrae*, the masonry of which, as well as the size and cut of its stones, is quite Greek in appearance. Remains of mosaic floors are still found in the midst of its ruins. The masonry of the ruins of buildings which may be attributed to the Maccabean or Asmonean kings, displays also a Greek character. JOSEPHUS mentions the citadel and gymnasium erected in Jerusalem under the tyrant Antiochus Epiphanes. This, as well as the intercourse between the Maccabees and the Lacedaemonians, must have contributed to the introduction of Greek art in Jerusalem, as well as in the rest of Palestine. Hardly any other monument, however, can be mentioned as still existing in Jerusalem of that period, but the rock tomb called that of S. James the Less, which displays a porch ornamented with two Doric columns and two piers of the same order. The Roman period of art among the Jews may be dated from the reign of Herod the Great, B.C. 37. What remains of the wall of the enclosure of the outer temple with its eastern (or golden) and southern gates, may be fairly attributed to his re-edification of the temple. The ornamental character of these gates, as well as of the several capitals found in the vaults under the Haram Eshereef (all engraved in the work by PIROTTI), partakes of the Roman style such as it was used in the East. It is also found displayed on the façades of the tombs of the kings, an undoubted Herodian work, bearing in the very centre of its frieze a bunch of grapes, the special emblem of Herod the Great. Many other tombs about Jerusalem and other parts of Palestine have their outer entrances adorned with cornices of this Roman period; while the tombs of Absalom and Zacariah, in the immediate neighbourhood of Jerusalem, have been evidently *modernized*, as before noticed, by the Romanizing mania of Herod. But what characterizes particularly the architectural work of Herod, is the immense size of the stones (more than 30 ft. long in some instances) which he employed in his walling, and their particularly flat rusticated face, which caused them to be called *rebatated* (not *bevelled*) stones by WIGLEY, *Archaeological Studies on Jerusalem*, read at the Royal Institute of British Architects 25 February and 10 March 1856, which mentions some other remains of Jewish monuments still to be found in Palestine. Vocûë, *Les Eglises de la Terre Sainte*, 4to., Paris, 1860.

The pools of the Jews belong more to engineering than to architecture. They are to be found of all sizes about Jerusa-

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lem; but the largest are those now existing at Khan el Borak, the ancient Etham, at three hours distance southwards on the road to Hebron, and known as the pools of Solomon. The largest of these is 619 ft. long by 253 ft. wide and 50 ft. deep. They are formed, like most of the other pools, by a solid dyke of masonry built across a narrow valley. JERUSALEM. G. J. W.

With regard to the suggestion, made in the preceding article, that rebated masonry indicates work which may be referred to the period of Herod, it may be sufficient to remark that ROBINSON, iii, 511, notices what he wrongly throughout his book calls bevelled work, *i. e.* rustication, on the north wall of the basement of the great temple at Baalbec, and this alone is sufficient to impugn the deduction sought to be drawn from the tower Hippicus at Jerusalem. He notes in the same volume other cases of such masonry, 15, at Deir-el-Kulah; 52, at Khulat-es-Shekef; 113, at Seffurieh; 329, at Bethsan; 371, at Hunin; 403, at Banias; 417, at Hibbariyeh; 432, at Kulat-Antar; 461, at Damascus; and 493, at Migdel: and some of these he unequivocally calls temples.

HECATOMPEDON (Gr. *ἑκατόμπεδον*). A name given by the Greeks to the temple of Minerva at Athens, the word expressing one hundred Greek feet, which number is supposed to have been the breadth of the temple on the top step, and is found equal to 101·341 English feet according to PENROSE, *Principles*, etc., fol., Lond., 1852. Both STUART, and REVELEY, *Athens*, 1794, had given the dimensions of various other parts in order to obtain the nearest approach to the ancient measure. PLUTARCH, *Pericles* 13, *Glor. Athen.* 7, gives the name "Parthenon Hecatompados" to this building.

HECK. A HATCH or half door, a term in use in Yorkshire. ARCHÆOLOGIA, xvii, 149.

HECKELER or HECKLER (JOHANN), was born at Dreken-dorf, in Würtemberg. In 1615, as *baumeister*, he measured the height of the northern tower of the münster at Strassburg, and directed the works from 1622 to 1643. 68, 112.

HECKELER or HECKLER (JOHANN GEORG), born in 1628, a son of the preceding, was also engaged on the münster at Strassburg from 1654 to his death in 1669. He repaired in the space of three years the northern tower, which was greatly damaged in 1654 by lightning, first removing 19 metres of its summit, and reconstructing it again, raising it 62 centimètres. He left some manuscript notes on the repairs executed by him, and perhaps also a manuscript description of the münster, dated 1665. 68, 112.

Another Johann Georg HECKLER is mentioned as contracting 8 July 1682 with the bishop to enlarge and repair the choir; he completed it in six months, the *jube* was taken down and the high altar removed. GRANDIDIER, *Essais*, etc., sur l'Eglise, 8vo., Stras., 1782, pp. 135, 155, 227-9, and preface, notices all three names.

HECKERIS (HEINRICH), was *baumeister* 1331 to the cathedral of Würzburg. 92, 116.

HEDDINGTON STONE (also written Headington and Hedington). This stone is a portion of the oolitic formation, that occurs in considerable beds at the village of Heddington, about one mile and a half from Oxford, where it was largely used in the public buildings; and is said to have been employed in those parts of Westminster abbey that were built in the time of the later Tudors; Sir C. Wren is reported to have used it in the restorations of the same building. It is, however, of a very uncertain character, and contains many veins and beds that are decidedly of an earthy and very friable nature, so that its selection requires the greatest care and attention. It can be raised in blocks of about 10 or 20 ft. cube; the labour on it may be assumed as being rather less than that of Portland stone; the resistance to crushing is also less. G. R. B.

"The quarry is of considerable extent and utility; the stone is of two sorts, termed freestone and ragstone. It is very porous, and cuts 'soft and easy' in the quarry, but hardens when exposed to the weather; the vein is from 12 to 14 ft. deep, but is

not worked to the bottom, as it there becomes too soft and sandy for use. Of this stone the more substantial parts of many structures in Oxford are composed; but it is too coarse and porous for the ornamental divisions—it also varies much in quality, the soft and the hard lying indiscriminately mixed in the quarry. It will not bear the fire, but is well adapted to all other circumstances of exposure, and has been used in the building of many elegant bridges"; *Beauties of Oxfordshire*, 8vo., London, 1813, 262, 324, 379:—such as that at Dorchester, building in 1812; that at Henley on Thames, 1786, etc. Many of the buildings at Oxford are, more or less, in a deplorable state of decomposition; the plinths, string courses, etc., mostly of a shelly oolite from Taynton, are in good condition: several of them, therefore, have of late years been rebuilt or refaced; C. H. SMITH, *Lithology*, in *Transactions of the Royal Institute of British Architects*, 4to., London, 1842, 132. BUCKLER, *Observations on Magdalen College*, 8vo., London, 1823, 171, remarks, "I cannot account for the preference given at Magdalen to Bath stone instead of that of Headington—whose extensive quarries, several of which belong to this college, have for many years supplied Oxford with materials for building.—Of its excellence, both as to colour and durability, when properly, and I may say naturally, laid in courses, nothing need be said, since some of the finest structures of antiquity in Oxford bear ample testimony to it; and no one more strikingly than this college, whose tower gateway, great tower, and chapel, are at this day as perfect in the detail of their moldings and ornaments as they ever were; while on the contrary, the church of All Saints (Bath stone) presents a rotten exterior, whose decay no repair can improve, no experiment avert". The foundation stone of Magdalen college was laid 5 May 1474—the quarry of Headington, which had been discovered in the reign of Henry III, was then in higher repute than that of Hinxey (HEARNE, *Lib. Nig. Scacc.*, App., p. 570), and from it the stone for the edifice was taken—and contracts were made in 1475, 1478-9, with William Orchyerd, mason; CHANDLER, *Life of Waynflete*, 8vo., London, 1811, 137. By an agreement with bishop Waynflete, a considerable quantity of Headington stone was supplied for the works at Eton college during the first year, 1441-2: TIGHE and DAVIS, *Windsor*, 8vo., London, 1858.

HEDDON STONE is obtained at Heddon on the Wall, near Newcastle on Tyne, Northumberland. It is a sandstone composed of coarse quartz grains and decomposed felspar, with an argillo-siliceous cement, and ferruginous spots; a light brown ochre in colour; and weighs 130 lbs. 11 oz. per cubic foot. The beds are from 4 to 12 ft. in thickness. Among the buildings erected with this stone are the Norman chancel of Heddon church, and its steeple, dating 1764; the columns of the portico to the theatre; the Grey monument, and nearly all the buildings, ancient and modern, in and about Newcastle; *Report on Building Stones*, fol., 1839; which, however, also remarks that the modern buildings "erected within the last twenty-five years" are of sandstone from the Felling and Church quarries at Gateshead and the Kenton quarry, parts then showing symptoms of decomposition. S. Nicholas church (fourteenth century) was built of similar stone to that of Heddon, and was very much decomposed; parts restored within the last century were decomposing, and the tower and spire, restored about 1834, were painted for the preservation of the stone.

HEDERA, see IVY.

HEDGE, in landscape gardening, one of the most lasting and effectual of fences, when well made and kept in good order, and more effectual than walls in keeping out trespassers. The best shrub for this purpose is the prickly leaved holly, but it is slow of growth, and expensive to plant: the yew is the next best. The various kinds of thorns are well adapted to form hedges, and are consequently most commonly used. For high and strong hedges, the hornbeam and a variety of the beech, that throws out many branches from the stem, are

extensively used in old gardens, where geometrical figures and numerous angles are admired. Elder trees grow very rapidly, and by sending out many long hollow branches, soon form a good fence against cattle, but it is not close or ornamental: sweetbriar forms a good fence against sheep, it grows quickly, and is useful in pleasure grounds. The privet is very common, and is also a quick growing shrub; and with the black and white thorns, are among the commonest and most useful of the shrubs planted in the hedges of fields. The *pyrus japonica*, bearing a beautiful flower, and growing close and prickly, would be found very serviceable for the same purpose. In Holland and Flanders, shrubs are often trained along stakes and rods to form a hedge; and in this country, methods of *plashing* and of *laying* a hedge are adopted to renew it. 14.

HEDGERLEY (sometimes called WINDSOR) BRICK. A fire brick (formerly) made near Windsor, of a very fine red colour, very hard, and used in and about furnaces, where it stands great heat without damage. The loam, of a yellowish colour and very harsh to the touch, containing a great quantity of sand, is used for setting these fire bricks, and for coating furnaces, etc.; WARE, *Body of Arch.*, fol., London, 1767, 59. FIREBRICK.

HEDON (HUGO) succeeded R. Patryngton (the year of whose death, after 1370, is not known) as master mason at York cathedral, having twenty-eight masons under him, in 1398; in 1401 he was at work with twenty-four masons. W. Colchester was master mason in 1415. During the above period the eastern part of the choir was erected and the crypt completed; BROWNE, *Hist. of York Cath.*, 4to., York, 1838-47.

HEEK. A term applied for the RACK placed over the manger in a stable. It is spelt HAIK in Scotland. 1.

HEEL. A term formerly applied by workmen to an inverted ogee, or *cyma reversa*. 4.

HEEL OF A RAFTER; OF A POST, etc. The term applied to the end or foot of a rafter that rests on the wall plate; and to the bottom of a post where it is set in a cill.

HEEL TOOL. A term given to the tool used by turners for roughing out a piece of iron, or turning it to somewhat near the intended size. It has a very acute cutting edge and an angular base or heel.

HEENWINKEL (. . .) built or continued the castle of Frederiksborg in Denmark, 1606-20, one of the latest Gothic works in that part of Europe. It was destroyed by fire in December 1859, as noticed *s.v.* COPENHAGEN, wherein it is dated 1588-1648.

HEERE (JAN MINHEER), also a sculptor, was employed at the church of S. Bavon at Ghent, at the beginning of the sixteenth century, and one of the best artists of his time. BRULLIOT gives, from PASSAVANT, the monogram of this artist, which he affixed to his works and to his receipts; in it the letter A appears, which is said to have been intended to show that he was an architect. His death is not recorded. 68.

HEFELE (MELCHIOR), called also Weinkopf Hefel, was born at Kaltenbrunn in the Tyrol. In 1742 he received at Vienna the first prize for architecture, where he was afterwards employed, and designed many triumphal arches, funeral decorations, altarpieces, etc.; among the latter, that in the church of Sontagberg in Lower Austria, has been much praised; the metal bas-reliefs are said to have been cast by him. His death is not recorded. 26. 68.

HEGER (FRANZ) was born at Worms in 1792, and studied at Darmstadt and at the university of Giessen. From 1810 he studied architecture under Möller at Darmstadt, and under Weinbrenner at Karlsruhe. According to NAGLER, he travelled in 1814, with Hübsch and Thürmer, from Rome to Greece; the results of their investigations were published in a work, *Athen, mit seinen Denkmälern in 26 malerischen Ansichten bekannt*, Darmstadt, 1823; he also published a view of the temple of Minerva as it existed in 1818, fol., Darmstadt; and with G. Möller, *Entwürfe ausgeführter und zur Ausführung bestimmter*

Gebäude. But according to MÜLLER, he visited between 1817-21, with Weinbrenner, Germany, Italy, Greece, and France. Two large cavalry barracks, given in MÖLLER, *Entwürfe*; and the theatre designed with Möller 1818-9, both at Darmstadt, are the most prominent of his architectural works. He was appointed *land-baumeister* to the grand duke of Hesse at Darmstadt, and died there in 1837. The text to *Athen* was written by professor Creuzer of Heidelberg. COTTA, *Kunstblatt*, 1837, No. 2. 68. 116.

HEGER (PHILIPP and FRANZ), father and son, practised at Prague about 1792-6, where they produced many architectural works. They published thirty plates of coloured views of Prague; the list of the edifices, etc., represented in them is given by MEUSEL, *Künstlerlexicon*, 8vo., Lemgo, 1808-14, i, 370. 20. 26. 68.

HEIDELOFF (VICTOR PETER), *baumeister*, sculptor, and painter, was born in 1757 at Stuttgart. He studied, 1782-7, at Rome, by the assistance of prince Karl Eugene; and afterwards resided till 1790, in Paris. On his return to Stuttgart he was appointed professor at the Karlsruhschule, and also court and theatre painter. He chiefly practised as a painter. He died in 1816, partially blind. His son, Carl von Heideloff, architect, is still living. 69. 116.

HEIGELIN (KARL M.), *baumeister*, was professor of architecture at the university of Tübingen. He designed the new cathedral at Rottenburg, an account of which is given in *Erbauung einer neuen Cathedral zu Rottenburg*, 8vo., Tübingen, 1829, and published *Lehrbuch der höheren Baukunst*, 3 parts, 4to., Leipzig, 1828-33. He died at Stuttgart in 1833; COTTA, *Kunstblatt*, 1833, No. 66. 68. 116.

HEIGHT. The perpendicular distance between the two points to be measured. A useful list of the elevation of the principal towns of France, and the summit of a public building in them, which served for the points for triangulation in the trigonometrical surveys of that country, is given in the *Builder Journal*, 1862, xx, 294. ALTITUDE; MODULE.

HEIGHT OF AN ARCH. The measure of the versed sine, or of the space between the springing line and the intrados or soffit, of the arch.

HEIL (LEON VAN) was born 1605 at Bruxelles in Brabant according to NAGLER; or 1624 according to TICOZZI and MÜLLER. He was architect to the archduke Leopold; but nothing is known as to his architectural works, except the erection 1673-5 of the chapel of S. Mary Magdalen at the back of the choir of the church of SS. Michel and Gudule at Bruxelles; the altar was brought from the abbey of La Cambre. He was also a painter, and etched several plates. His death is not recorded. 62. 68. 101. 117.

HEIL, see HEALING and HELE.

HEIMO designed the choir of the cathedral church of Notre Dame at Maestricht, in the twelfth century; in one of the capitals is a portrait of him offering a carved capital to the Virgin; WEALE, *Belgium, etc.*, 8vo., London, 1859, 321.

HEINARDUS (MAGNUS or SAPIENS), see EGINHARDUS.

HEINDRICKX or HENRICK of Antwerp was the chief workman employed in building the first Royal Exchange at London, 7 June 1566—Nov. 1567, for Sir T. Gresham; *Royal Exchange; Extracts from the Records of the City of London*, etc., 1564-1827, fol., London, n.d. BURGON, *Life of Gresham*, 8vo., London, 1839, ii, 115, states that the materials were brought from Flanders, and that a Flemish builder of the name of "Henryke" was the architect employed. EXCHANGE.

HEINRICH, was *baumeister* at Titmoning in Austria, according to the inscription in stone over the entrance of the old town-gate, "anno MCCCCLXVI—est ista turris per nobilem virum Pangracium Paumann a primo fundata et per discretos viros et magistros Henricum et Stephanum muratores et cives hujus loci de novo constructa." 68.

HEINRICH (MEISTER) was *baumeister* at Ulm cathedral in 1378. 92.

HEINRICH, see BREMEN, GMEUNDEN, and SUNERE.

HEINRICH III, abbot of the convent of Walkenried in Brunswick, from 1223-1231; is noticed as a clever architect, and as keeping in the convent twenty-one pupils (*conversos*) who worked in stone and metal under his direction; ECKSTORM, *Chron. Walkenredense*, 4to., Helmstaedt, 1617, p. 87.

HEINRICH DER LEITTRER, was one of the *baumeisters* employed 1332 on the works of the münster at Freiburg im Breisgau; SCHREIBER, *Das Münster*, fol., Fr., 1826. 116.

HEINZ or HINZ (DANIEL), *baumeister*, finished in the year 1573 the vaulting of the nave of the münster at Bern. 116.

HEINZ or HINZ (MATHIAS), *baumeister*, commenced the münster at Bern, the foundations of which were laid in 1421: Stephan Pfuter continued, and Erhard Küng of Bern finished it. This Heinz probably built 1444 (1344 s. v. Bern) the wall 108 ft. high which supports the ground at the *place* in front of the cathedral. He was engaged at the same period on the Frauenkirche at Esslingen. According to MÜLLER he is the same person as the famous Matthäus Ensinger, the son of Ulrich, foreman (*werkmeister*) at the münster of Strassburg, the family having adopted the name of Ensinger, being a native of that place. Mathias died 1463, as noticed s. v. ENSINGER. 68. 92. 116.

HEINZELMANN (CONRAD) of Ulm, was 1429 *baumeister* at the Georgskirche at Noerdlingen; later, busy at Landshut and Waiblingen; and built with Hans Bauer of Ochsenfurt on the Lorenzkirche at Nuernberg, 1459-77, from the design of Conrad Roriczer. HANS of Ulm. 92.

HEISTERIA COCCINEA, Partridge wood, is the produce of the West Indian Islands, and of the Brazils. It is sent in large planks, or in round and square logs, called from their tints, red, brown, and black, and also sweet, Partridge. The wood is close, heavy, and generally straight in the grain. The colours are variously mingled and most frequently disposed in fine hair streaks of two or three shades, which in some of the curly specimens cut plankways resemble the feathers of the bird: other varieties are called "Pheasant wood". The wood is porous; cut horizontally, the annual rings appear almost as two distinct layers, the one of hard woody fibre, the other a much softer substance thickly interspersed with pores: this circumstance gives rise to its peculiar figure. It is now used for cabinet work, in turning, and for sticks; formerly it was employed in the Brazils in ship-building. In the English dockyards it is also known as "Cabbage wood": the red coloured variety is called *angelim* and *cangelim* in the Brazils; and *yava* in Cuba; while one of the Admiralty specimens is marked "Bastard Cabbage wood" the produce of ANDIRA inermis; HOLTZAPFFEL, *Woods*, etc., 8vo., London, 1843, 99. ARCHER, *Pop. Econ. Botany*, 8vo., London, 1853, 337-8, says it is much doubted whether this is the wood of the Heisteria. 71.

HELD (PETER) was in 1622 a *steinmetz* and *baumeister* at Ulm. He was engaged by the town council to construct the portal for the Frauenthor; but neglecting the work, and leaving it secretly in 1623, he was replaced by Daniel Schopf of Isny. He made a design for the façade of the church at Schorndorf, which is considered a beautifully executed drawing, and is still preserved in the "Furtenbach's Kunstkammer" at Ulm; WEYERMANN, *Nachrichten von Künstlern*, 8vo., Ulm, 1829, ii, 169. 68.

HELE and HEIL. "In the western parts of England", says Lord KING, *Hist. of the Apostles' Creed*, 8vo., Lond, 1703, p. 178, "at this very day, to *hele* over anything signifies among the common people to cover it; and he that covereth an house with tile or slate is called a hellier". To 'heal' or 'hele' a church, etc., was a term likewise used in Sussex in 1734; LANGLANDE, in *Piers Plowman* (cir. 1350), notices the cloister of a convent as "hyled with lede"; and CHAUCER (cir. 1385), *Canterbury Tales*, l. 87 of "the Cokes tale of Gamelyn", says "his howses were unhilid and ful yvel dight."

HELIAEA (Gr. *ἡλιαία*). The name of a court for the

trial of the weightiest causes at Athens; each judge was called a heliast, and from this word is derived the adjective 'heliastic', to which reference is made in the following article.

HELIASTERIUM and **HELIOCAMINUS**. These words derived from the Greek language, represent the place where, as in Italy, the chilly native basks in the sun's warmth during temperate weather: such are the loggias and belvederes on the tops of the houses. But although ISIDORUS had plainly declared that *solaria* as well as *maniana* were *plana tecta*, SALMASIUS commenting upon the *Hist. Aug.* 8vo., Leyden, 1671, i, 676, insisted that *protecta* and *projecta tecta* were the proper rendering for ἡλιαστήρια, ἡλιαστικά, ἡλιοκάμνοι and ἐξωσταί, which he allowed were the maniana vel solaria quæ in planis tectis struebantur. The real sense of the word *heliastic* may be seen in the preceding article: the *exostes* was probably the projecting window now common to the traveller at Cairo or at Jerusalem: and possibly the solarium vel manianum of ISIDORUS, as well as the heliasterium of STRABO and the heliocaminus of PLINY, *Ep.*, ii, 17, (who says "in hac [cryptoporticu] heliocaminus quidem, alia xystum, alia mare, utraque solem prospicit,") may be allowed to have been lanterns or niches sheltered from the northerly winds. Nero constructed a heliocaminus (literally, sun fireplace) on the porticus of his "golden house." **MENIANUM**.

HELICAL LINE OF A HANDRAIL. The spiral line twisting round the cylinder, representing the form of the handrail before it is molded.

HELICOGRAPH. A description of an instrument, invented by Messrs. Penrose and Bennett, for describing the volutes and scroll work found in Grecian architecture, and called the screw helicograph, was given at the Royal Institute of British Architects 10 March 1851.

HELIEIUM (Gr. ἡλιεῖον). A temple or place sacred to the sun.

HELIOPOLIS (Heb. *Bethshemesh*; Egypt. *On*; Arab. *Ain Shems*). A city, destroyed by Cambyzes 525-1 B.C., but now represented by the village of Matariyeh, about six miles north-west of Cairo in Egypt, from which the obelisk of Ramses I, B.C. 1395-55, now at the piazza del Popolo and that of Psametis (B.C. 670-570) at Monte Citorio in Rome, are said to have been taken by Augustus. The *Description de l'Egypte* (Antiquités), v, 66-97, pl. v, 26, gives a plan of the ruins, which occupy a quadrangular area of about three-quarters of a mile by half a mile, with details of the obelisk still standing: this being marked with the name and titles of Sesortesen I, is regarded as the earliest dated specimen (about 2800 or 2300 B.C.) of Egyptian art after the Pyramids. Some remains of sphinxes with fragments of a colossus, were all that remained at the commencement of the present century to mark the site of a building which STRABO took as his example for a description of the Egyptian temples. The *Architect Journal*, 1850, ii, 478, notices the discovery and removal of two stone pylons and a brick wall, all inscribed with the name of Thothmes III (B.C. 1495-1456) whose obelisk at Alexandria, known as Cleopatra's needle, was originally placed at Heliopolis.

HELIOPOLIS. The name given to BAALBEC by the Seleucidian sovereigns of Syria, and continued by the Romans.

HELIX (Gr. ἑλῆξ). This word has been used to express a turn, a twist, a tendril, a curl, a spiral line, a screw, and later an arch or a vault. The Romans, while they used the word *voluta* for the angular spiral of the capitals of Ionic and Corinthian columns, retained the term *helix* for the smaller voluted foliage in the middle of each face of the Corinthian capital; thus VITRUVIUS, iv, 1, "minoresque helices intra suum medium". There are sixteen *helices* in the best and perfect examples; two occur at each angle and two meet under the middle of the abacus, branching out of the caulicoli or stalks, which rise from between the leaves. They are also called *urille*.

HELLENIUM (Gr. ἡλλήνιον). The name given in HERODOTUS, ii, 178, to the temple built, apparently at Naucratis in

Egypt, with permission of Amasis, B.C. 579-25, by the cities of Chius, Teos, Phocæa, Clazomenæ, Rhodus, Caidus, Halicarnassus, Phaselis, and Mytilene, for the use of the Greeks who traded to Egypt.

HELLING, ELLING OR HEALING. A North Devonshire term for roofing. **HELE**.

HELLWIG (JACOB), *baumeister*, in 1522 assisted to finish the reliefs of the gallery in the church of S. Ann at Annaberg, partly after the designs of Dürer; KUGLER, *Handbuch der Kunstgeschichte*, p. 806.

HELMDON QUARRY, in the county of Northampton, is said to have supplied the stone in the building of Easton Neston by N. Hawksmore, for Baron Lempster, of Leominster, about 1702. "It is a fair white and durable stone, freer from an intermixture of yellowish spots than is that of Ketton, and is indeed the finest building stone I have seen in England"; MORTON, *Nat. Hist. of Northamptonshire*, fol., London, 1712, p. 493.

HELOWE WALL. The hell-wall or end wall that covers and defends the rest of the building; as "In solutis eidem Domine pro quodam helowe wall unius domus apud Curtlyngton annuatim ii den"; KENNETT, *Par. Antiq.*, 4to., Oxford, 1695, p. 573, and Gloss.

HELPSTONE (JOHN) built by contract 1322 for the citizens, in the walls of Chester, the new or Water tower, 24 ft. in height, for the sum of £100; LYSONS, *Mag. Brit.* (Cheshire), 4to., London, 1810, 613, who calls him "architect".

HELVE. The name given to the HANDLE of an adze or axe.

HEM. The name given to the spiral projecting part of the Ionic capital, which may be a translation of the Fr. *bord* or *ourlet* applied to the fillet of the volute.

HEMI. A Greek word signifying 'half', often prefixed to architectural terms.

HEMICYCLUM and **HEMICYCLUS** (Gr. ἡμικύκλιον). These words, meaning half of a circle as used by VITRUVIUS, v, 1; ix, 9, appear to have become the names for a room of that shape, CICERO, *De Amicitia*; and for an EXHEDRA, erroneously termed amphitheatre in some translations of PLUTARCH, *Alcibiades*, 17, and *Nicias*, 12.

HEMIGLYPH. The half-channel on each of the two sides of a triglyph.

HEMITRIGLYPH. The portion of a triglyph which sometimes occurs in an internal angle of a returned frieze which has triglyphs in it.

HEMLOCK SPRUCE FIR, *Abies Canadensis*, is often used in America in the cheaper kind of carpentry. It is indigenous to nearly all places favourable to the production of spruce and the light pines. In dry situations, when the wood has been carefully seasoned and protected from the action of the sun, it may be considered as a fourth rate wood. Its peculiar structure, tending to twists or clefts in the grain, makes it entirely unreliable for large timbers, where resistance either to tensile or to compressive strain is required. The *Builder Journal*, xvi, 61, records the case of a malt store in America, falling in, as the hemlock beams were unable to carry the weight, which those of pine timber would have done. It decays quickly in damp situations; and if exposed while in an unseasoned state, the heart-wood cleaves from the surrounding wood by the action of either the sun or the wind. Even the best specimens are only usually cut into small studding joists or common boards. Hemlock possesses one good property, in the tenacity with which it adheres to a nail; an ordinary tennypenny cut nail, if driven into the wood half its length, will part before it can be drawn out—a quality of first importance for common or rough boarding in shingling, slating, clapboarding, etc. The sap possesses an intense and somewhat unpleasant odour. The wood is unfit for use while in an unseasoned state, as it corrodes iron immediately at the part where it begins to project from the wood, the colour of which is a light brown: a cubic foot weighs when dry 27 lbs. It

shrinks when seasoning a little less than spruce, and loses one-fourth of its weight. SILLOWAY, *Textbook of Modern Carpentry*, 8vo., Boston (Amer.), 1858. ABIES. Hemlock spruces are called black, white, and red, according to the colour of the bark and not of the timber, which is white. "The American hemlock pine possesses the property of not burning with readiness, requiring a strong fire to consume it"; YORKIE, in *Papers of Corps of Royal Engineers*, 8vo., London, 1852, new ser., ii, 92.

HENDERSON (DAVID). Having surveyed 1769 the bridge at Edinburgh, he was again employed July 1774 to report on its then state, as given in the SCOTS MAGAZINE, xxxvi, 108. He also designed and constructed a stone bridge over the deep ravine called the Pease or Peaths on the road from Dunbar to Berwick upon Tweed. It consists of four semicircular arches, the eastern one is 54 ft. span, the next 55 ft., 52 ft., and the two western 48 ft. each; the height from the bottom of the ravine is 124 ft.; REES, *Cyclopadia*, 4to., London, 1802, etc., s. v. Bridge. The spandrels are lightened by cylindrical openings.

HENDERSON (JOHN), born 1804 in Brechin, was a pupil of T. Hamilton. He erected 1837 S. Mary's chapel at Dumfries; 1837-8 the church at Morningside; 1839 Trinity episcopal chapel, Dean bridge; S. Columba's episcopal chapel, Castle-hill; S. Luke's free church, Queen-street, all three in Edinburgh; 1848 S. John Scottish episcopal church, Glasgow; private chapels at Ardgowan and at Dalmahy; 1858 S. Peter's episcopal chapel at Montrose; the Montrose museum; S. Mary's church, and the steeple of the established church at Arbroath; some public buildings at Brechin; the Burntisland pier; and a large number of churches in various parts of Scotland. Trinity college, Glenalmond, is his chief work. He died at Edinburgh in June 1862.

HENEGOUWEN (JAN VAN) designed and commenced 1321 the tower of the dom at Utrecht. BLONDEEL, *Beschryving der Stadt Utrecht*, 8vo., Utr., 1757, says that it is the loftiest in the kingdom; it was finished in 1482 by BURCH. 24.

HENFORKES. In the contract for building the bridge at Catterick in Yorkshire, 1421-2, it was agreed that the masons should "make a luge of tre"—of "iiij romes of syelles and two henforkes"; it is supposed that the former term meant a ridge roof formed by principals, and the latter term the lean-tos or pent houses; ARCHÆOLOGICAL Journal, 8vo., London, 1850, vii, 56-9; 292-5.

HEN HOUSE, see FOWL HOUSE.

HENNERT (KARL WILHELM), was born 1739 at Berlin, and studied under Major Humbert. He was architect to prince Henry of Prussia, and built for him the town-hall and the theatre, with other works at Reinsberg in the province of Brandenburg. In 1785 he was appointed *ober-bauinspector*; and died at the end of the last century. 68.

HENRI (GUILLAUME JOSEPH) was born 20 March 1754 at Dinant in Belgium. He went at an early age to Rome, where he obtained 1778 the first prize for architecture at the academy of S. Luke, and the title of honorary professor in the same academy for his plan of a palace for the congregation of cardinals. He went afterwards to France, where he was appointed architect to king Louis XVI, and built with Cruzy, amongst many other edifices, the theatre and hospice des Enfants Trouvés at Nantes; and restored the ruined buildings at Valenciennes; he afterwards returned to his native country, and designed for prince Charles a palace and a theatre, which, however, were not executed. He restored in 1815 the (pl. 1-3) theatre, orangery, and decorations of the royal palace at Laeken (built by Montoyer); built the château du Duras near S. Troyen or Trond in Limbourg, 1789, for M. le comte van der Noot (pl. 50); and that of Zangri near Maestricht; a house at Louvain; the entrance gateway to the *parc* of Engghien; and at Bruxelles, the façade of the palais royal, garden side, the pavillon de plaisance in the faubourg of Namur, and the theatre of Inau-

guration 1815 of S. M. William I, prince of Orange, Nassau, etc.; GOETGHEBUER, *Choix des Monumens*, fol., Ghent, 1827, pl. 19. He was successively architect to the emperor of Austria in 1793; to Napoleon I. in the year xiii (1805); and to William (afterwards, 1814-30, king of the Netherlands) in 1802. He was also member of the Legion of Honour; and died at Bruxelles 3 February 1820. HENRY. 101. 116.

HENRIQUE (EL MAESTRO) was engaged about 1277 on the works of the cathedral at Leon in Spain. According to the registry of deaths in that church he died 7 July 1315. As the building was begun in 1199, he might have been the second or third architect engaged. 66.

HENRIQUEZ (ALFONSO) is supposed to have constructed the portal of the cathedral at Lamego in Portugal; RACZYNSKI, *Les Arts en Portugal*, 8vo., Paris, 1846, p. 378, supposes the building to belong to the reign of John I. (1385-1433), or perhaps a little earlier.

HENRIQUEZ (FILIPPE) contracted for a part of the works of the Batalha about 1517; RACZYNSKI, *Les Arts en Portugal*, 8vo., Paris, 1846, p. 344.

HENRY (. . .) of Paris, is said by NAGLER to have been practising in 1780. According to KRAFFT, *Plans, etc., Maisons et des Hôtels*, fol., Paris, 1802 (?) he designed 1786, pl. 113, the salle de spectacle des cidevant jeunes artistes, boulevard du Temple; KRAFFT also gives (pl. 62) 1788 l'intendance et la cidevant école des ponts et chaussées, rue S. Lazare; with pl. 82, the decorations of the dining room; pl. 16, 1788, and pl. 27, 1790, two houses for M. Vassale, rue Pigalle, near the rue chaussée d'Antin; pl. 11, 1795, the maison de Lakanel, afterwards Genl. Moreau, in the rue du Mont Blanc; and pl. 52, 1795, his own house in the rue de Michaudière. The elevation of the théâtre des élèves de l'opéra, boulevard du Temple, is given in KRAFFT, *Choix des Maisons*, etc., fol., Paris, 1838, pl. 91: this building was destroyed about 1837. Labarre commenced in 1805 the colonne de la Grande Armée at Boulogne, but dying in 1833, the works were carried on by Henry and completed 1840; GOURLIER, *Choix d'édifices*, fol., Paris, 1825-52, iii, 119, 120, 384. SUYS.

HENRY OF S. ALBANS, was one of two masons working at the new chapel of S. Stephen, Westminster, at its commencement 17 June 1330 for six days at 5*d.* per day, and later; probably under T. of CANTERBURY. SMITH, *Antiq. of Westm.*, 4to., London, 1807, 181.

HENRY *Lathomus* (stonemason), died 1319, having been engaged in building (artificiose composuit) the chapter house, the refectory, with the abbot's hall and kitchen, at Evesham in Worcestershire; LELAND, *Collect.*, 8vo., London, 1770, i, 249.

HENRY, see NARBONNE (HENRY OF).

HENRYKE, see HEINDRICKX.

HE-OAK, the *Casuarina stricta*. A tree of Van Diemen's Land of no great beauty or value. 71.

HEOSE (WILLIAM), mason, in 1314 contracted with Sir John Bishopsden, of Lapworth in Warwickshire, knight, to build him a convenient house of freestone (*perre fraunche*) 40 ft. long and 18 ft. wide inside the walls; this, one of the earliest building contracts known, is given in TURNER and PARKER, *Dom. Arch.*, 8vo., Oxford, 1853, ii, 5.

HEPTASTADIUM, see STADIUM.

HERACLEIA (Gr. Ἡράκλεια). Amongst the numerous towns to which this name was given, the most important to the architect seems to be that whose ruins, on the borders of the lake of Baffi or Capoumoulu, at the western foot of Mount Latmus, were supposed to be those of Myus by CHANDLER, *Travels in Asia Minor*, 4to., London, 1774, pp. 165-8, quoted in the DILETTANTI SOCIETY, *Ionian Antiquities*, fol., London, 1797, ii, 27, pl. 33-5, which gives a view of the lake, a plan of a temple, and details of one Ionic and two Doric cornices, etc. The correction made by REVETT's MS. notes in the copy of Chandler's book in the British Museum, was confirmed by LEAKE, *Travels in Asia Minor*, 8vo., London, 1824, p. 239,

and by an inscription discovered by DONALDSON, who in the supp. vol. to STUART, *Antiq.*, fol., London, 1830, pp. 13 and 35, noticed the perfect condition of the parascene of a theatre hewn in the mountain. This is described by REYER, who noticed some mossy remains of the wall of the proscenium, but the marble seats are removed: a quadrangular area, conjectured to have been the agora, edged with marble fragments: stones ornamented with round shields, by one of several terraces with steps cut as at Priene: and a small temple in *antis* (supposed to have been dedicated to Bacchus), which is seated on an abrupt rock; only the front, which is towards the east, being accessible; the roof was destroyed; the *cella* had been well built with a species of red granite, but the front of the pronaos with white marble. The wall of the city was still standing, except towards the water, and had square towers like that at Ephesus. Outside the city were innumerable stones which served as covers to the rock-cut graves, the surface of these lids being generally sloped in the form of a low roof gabled at each end.

HERACLEIDES (Gr. Ἡρακλίδης) employed at the siege of Tarentum, B.C. 212-209, and imprisoned by Philip of Macedon, B.C. 198, is mentioned by POLYBIUS, xiii, 4, as the inventor of the military engine called the sambuca. Another HERACLEIDES is mentioned in Greek inscriptions found in Egypt and dating about A.D. 115-6, given in LETRONNE, *Recueil*, 4to., Paris, 1842, i, 426, whence it has been inferred that the building of an Ionic order at Djebel Dhokan, and of the Corinthian order at Djebel Fateerch, might have been his work.

HERACLEIUM (Gr. Ἡρακλείον). The name for a temple dedicated to HERCULES.

HERACLEUM SPONDYLIIUM. A German author states that this plant is frequently mistaken for the ACANTHUS, the model for ornamental work in Grecian architecture.

HERAEUM (Gr. Ἡραῖον). The name for a temple dedicated to Hera, Here, or JUNO.

HERALDRY. The science which treats of the signs, cognizances, devices, and other marks of honour and dignity, which have been appropriated to sovereigns, communities, and high offices, or have been assumed or granted as personal or hereditary tokens of property, station, or rank. Its connection in modern times with architecture does not lead to such anomalies as the admirers of mediæval art would at first suspect: charges upon shields are described by Æschylus (fifth century B.C.) more intelligibly than is the case in some heraldic manuscripts written 1200-1500; and (not inferring the application of charges to the shields on the architrave of the Parthenon) richly ornamented shields and helmets formed a considerable portion of decoration of Roman structures, as well of works executed since the expiration of mediæval art. A very few hours would suffice to give the architectural student the knowledge which he will require of heraldic technicalities, so that he may observe the proprieties prescribed by the science; a careful perusal of any of the existing grammars will be enough for this purpose; and his memory will be assisted by the GLOSSARY of Heraldry, 8vo., Oxford, 1847. A very extensive list of works upon one or more branches of the science is contained in MOULE, *Bibliotheca Heraldica*, 4to., London, 1822; and mention should be made of PLANCHÉ, *Poursuivant of Arms*, 8vo., London, 1859. It is tolerably easy to ascertain the various charges, etc., from the coats of arms belonging to families in the United Kingdom, by looking for the name in the alphabetical collection formed by BURKE, *General Armory*, 8vo., London, 1847; this comprises additions to that of BERRY, *Encyclopædia*, 4to., London, 1828-30, which was an extension of that in EDMONDSON, *Complete Body*, fol., London, 1780.

The importance, even to the architect, of an "Ordinary" in heraldry, viz. of a classified collection of charges, can hardly be overstated: for instance, the east end of the church at Barsham is shewn in SUCKLING, *History, etc., of Suffolk*, 4to., London, 1846, i, 41, as being formed of ribs of stone fretted or crossing diagonally, and having the spaces between them filled with

glass for the window and with cut flints for the wall: a glance at a good "Ordinary", under the head *fretty*, should show that a family named Echingham bore *azure fretty argent*; and this family held about 1423-1523 the manor. Although BERRY reprinted from EDMONDSON, an "Ordinary" of eleven thousand shields prepared in the last half of the sixteenth century by the herald Glover, this is arranged in such a manner as to require some skill to make it available for reference: this difficulty has been remedied by PAPWORTH, *Ordinary of Armorial*, 8vo., Lond., 1858, etc., wherein the charges are so classed as to render the search, amongst sixty or seventy thousand coats, a matter of so few moments as to enable the generality of persons, though but slightly acquainted with heraldry, to ascertain with facility the family-name to which a given coat of arms is attributed. A collection of the arms, badges, and devices of the sovereigns of this realm has been printed by WILLEMET, *Regal Heraldry*, 4to., London, 1821, and its usefulness may be estimated by the example that it appropriates to Richard II the couchant white hart, which fixes the date 1377-99 of the string course in Westminster Hall: in like manner the presence of a Tudor rose is a clear indication of a date later than 1485. The solution of interesting questions which are caused by similarity of work in churches may sometimes be sought in the coats of arms which may happen to remain; and these churches will probably indicate the ecclesiastical (for abbeyes and cathedrals had their appropriate shields) or lay power to which the church was subject: such a shield, if it presents a corporate coat conjoined with that of the presiding officer, i. e. the bishop, abbot, or prior, at once supplies a date more precise than generally is afforded by family coats: for example, S. John's gate at Clerkenwell is marked with the coat of Thomas Docwra, prior of the hospital 1502-19. The employment of shields, crests, badges, and mottoes, for decoration in every material and in every place, as on bases, doors, jambs, spandrels, drips, strings, battlements, roofs, and faces of walls, on floors and in windows, on screens, stalls, tombs, and fonts, in every kind of building, military, domestic, civil, and ecclesiastical, is vindicated in the ASSOCIATED SOCIETIES, *Papers*, etc., 8vo., London, 1850-1, i, 37: other remarks by W. L. DONALDSON, *On Heraldry and its Connection with Gothic Architecture*, 8vo., London, 1857, were read at the Royal Institute of British Architects.

HERBANUM. The Latin name of ORVETO in Italy.

HERBERT (HENRY). The noble, whose family of Pembroke had employed at Wilton in Wiltshire, H. Holbein, Sol. de Caus, and I. Jones, besides other artists; WALPOLE, *Anecdotes*, edit. 1862. The same author notices that Wilton "received its last touches of beauty" from Henry the ninth earl—"who removed all that obstructed the views to and from his palace, and threw Palladio's theatric bridge over the river"; but this bridge was designed by R. Morris. The same earl is said to have designed cir. 1720, Wimbledon house, Surrey, for the duchess of Marlborough, who then owned the estate; it was burnt 1785; and rebuilt by H. Holland: cir. 1724 Pembroke or the new lodge, Richmond Park: about 1758 Marble Hill, Twickenham, for king George II, who erected it for the countess of Suffolk, mistress of the robes to queen Caroline; it was afterwards inhabited by Mrs. Fitzherbert, and subsequently by J. Lubbock, esq.; HASSELL, *Views of Seats*, etc., 4to., London, 1805: and the water house in Lord Orford's park at Houghton. DALLAWAY, in WALPOLE, *Anec.*, states that the earl strenuously supported the design by C. Labelye against those by N. Hawksmore and others for Westminster bridge, the first stone of which he laid in 1739 and the last in 1747, it having cost £389,500. He died 9 January 1750-1.

HERBERT (ROBERT) of Losinga, bishop of Hereford 1079, who died 26 June 1095, "was well scene in divers kinds of good learning, but in the mathematiques he was excellent; he built his church of Hereford anew, following the platforme of the church of Aachen"; GODWIN, *Catalogue of Bishops*, 4to., London, 1601, p. 372, quoted by MILNER, *Treatise*, 8vo.,

London, 1811, p. 42-3. It would appear, however, that Robert only commenced the choir.

HERBERT (WILLIAM), son of the above Robert, and called William Galsagus or Galfagus before the removal from Thetford, and de Losing or Losinga after his death 22 July 1119 or 20, was a native of Orford or of Syleham in Suffolk; or of Exmes (in Pago Oximensi), now Hiems, in Normandy, as named in the inscription put up in 1682. He removed 1094 the seat of the see from Thetford, of which he had been bishop from 1085, to Norwich, of which he became the first bishop, and erected there the cathedral, a palace, and the monastic buildings: the choir and its aisles, the east end with its chapels and the transepts, all still existing, are also ascribed to him. He also founded two churches in Norwich, one at Elmham, another at Lynn, and one at Yarmouth; BRITTON, *Norwich Cath.*, fol., London, 1816; Memoir by rev. W. T. SPURDENS, in *Papers of the Norwich and Norfolk Arch. Soc.*, 8vo., Nor., 1852, iii, 141-56, who gives therein an extract from the 14th epistle, cir. 1105, written by Herbert (ANSTRUTHER, *Epistolæ H. de L.*, etc., 8vo., Bruxelles, 1846), wherein he calls on Ingulfus, Willelmus, and Stanus, *apparés* (query, *apparitores*), to be more active in the prosecution of some ecclesiastical structure in which the king was associated with the bishop "*regis et mei ministri*"; these *apparés* were probably overseers of the works. HARROD, *Gleanings*, etc., 8vo., Norwich, 1857; WEEVER, *Monuments*, 4to., London, 1631, p. 788.

HERBOSUM MARMOR. A marble of a very fine green colour dug out of the quarries of Taygetus, which was greatly esteemed by the ancients. GREEN MARBLE. 2.

HERCE, see HEARSE.

HERCOS (Gr. ἑρκος). The Greek name for a hedge, paling, or wall, particularly considered as a fence, with reference to the *χύτρος* or court, in front of a mansion. The translations in INWOOD, *Erechtheion*, fol., London, 1821, pp. 56, 65, and 84, do not seem justified by the original text.

HERCULANEUM. A town of Campania, now Provincia di Napoli, in Southern Italy. After suffering A.D. 63 from an earthquake, it was buried 79, during an eruption of Vesuvius, not by lava, but by sand and ashes; these having been partially consolidated by water into a volcanic tufa, have assumed a more compact form than the materials which, ejected at the same time, covered Pompeii. Another town on this site is supposed to have been destroyed A.D. 472 in a similar manner. Excavations were made 1709-16, but the site of Herculaneum was not recognized till the discovery 1739 of the theatre; and as the villages of Portici and Resina occupy the ground at 60 ft. above them, the explorers have been obliged to work as in a mine: their tunnels exposed a villa, a forum with two adjacent temples of the Mater Deum, and of Hercules, and a BASILICA standing on the north side of the forum, from which a street, 36 ft. wide and bordered by porticos, led to a theatre, for which MAZois, *Pompeii*, fol., Paris, 1838, iv, may be consulted. The first representations seem to have been given in COCHIN and BELLICARD, *Observations*, 12mo., Paris, 1757, (2nd ed. (?); a translation, 8vo., London 1753), whose illustrations have probably served for other books, as for ROMANELLI, *Viaggio*, 8vo., Naples, 1817. IORIO, *Notizie sugli Scavi*, 8vo., Naples, 1827, cites the chief writers upon these excavations and exposes their faults, especially p. 32, with regard to those of SAINT NON, *Voy. Pitt.*, fol., Paris, 1786; but p. 100 he avails himself, however, of the illustrations by BELLICARD to that book. The minor objects that had been discovered were described and engraved by the REGALE ACCADEMIA EROCLANESE, *Antichità*, fol., Naples, 1757-92, which, i, 274, makes the remarkable observations that the paintings at Herculaneum are all, or nearly all, incontestibly in distemper; though some, of no importance otherwise, might be supposed to be in fresco; by the MUSEO BORBONICO; by DAVID, *Antiq. d'Herc.*, 12 vols., 4to., Paris, 1780-1803; and by BARRE, *Herculaneum et Pompeii*, 8vo., Paris, 1840. ZAHN, *Die Schönsten Ornamente*—aus P., H., and S.,

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3 series, col. plates, fol., Berlin, 1829-53. The three houses and some late Roman tombs, excavated 1828-37, had been examined a century earlier. 28.

HERCULES (the Latin form of the Gr. Ἡρακλῆς). A name given by the Pythian priestess to Alcæus or Alcides, the fabled son of Zeus and Alcmena. Hercules, Dionysus, and Pan, ranked as the three youngest deities worshipped by the Greeks; and the former seems to have been credited with the achievements of five, if not even of forty-three, predecessors. He was worshipped with the sacrifice of the bull, the boar, the lamb, and the ram; and was regarded according to HERODOTUS, ii, 44, both as a god and as a hero. Of the temples dedicated to him, the three most interesting to the architect are those at Brescia, Girgenti, and Pompeii; the second was inferior in size at Agrigentum only to that of Jupiter Olympius; and was nearly equal in plan to the Parthenon, which it exceeded in height. The chief antiquity at Cora is called a temple to Hercules; and so is one of the edifices at Pompeii. The club and the lion's skin are well known attributes of Hercules.

HERÉ DE CORNY (EMMANUEL, signing himself Mannel), also called Erez, and properly Hayré, was born 12 (not 14) Oct. 1705 at Nancy (not Sancy) in Lorraine. He was chief architect to king Stanislas, who is said to have designed 1752 the plan of the *place royale*, etc., at Nancy, and to have entrusted its immediate execution to Heré, whose works are given in some detail by PATTE, *Monumens*, fol., Paris, 1767, pl. 24-9, p. 15-6. They include, at Luneville, the towers, clock, and organ gallery of the church of S. Remy; and, in the gardens of the château, the pavillon and cascade of the canal, the kiosque burnt 1762, the pavillon, called from its plan 'le Trèfle', opposite the rocky, the rock at the foot of the terrace, and the menagerie; and the hôtel des Carmelites; the pavillon royal de Chanteux: the château de la Malgrange with its *commun* and *salle à manger*: at Commercy, the stables, the kiosque, the pavillon royal at the end of the canal, and the fountains in the park: the gallery of the château d'Einville; at Nancy, the church of Bonsecours, begun 1783, and the monastic establishment of the Minims, in the faubourg S. Pierre; the orphan house at the hospital of S. Julien; the buildings in the *place royal*, comprising the hôtel de ville, the hôtel des fermes, now the episcopal palace, the hôtel de M. Alliot; the hôtel de la Comédie or theatre with the collège des médecins in front of it; and the hôtel de M. Jaquet; the houses called "trottoirs Stanislas"; the triumphal arch; and the pedestal for the statue of Louis XV; and 1753, the *place* de la Carrière and its buildings, comprising the hôtel consulaire and the hôtel de la bourse, the building now called the cour impériale opposite to them, the fronts of the two ranges of houses reaching from thence to the *place* de l'Intendance, the *place* itself with the curved colonnades and their gateways, the palais de l'Intendance, and the public garden behind it; the hôtels of the *place* de S. Stanislas now d'Alliance, its fountain, and the maison de la Charité of the order of S. Jean de Dieu, now the maison Guérin, in the rue S. Catherine. He probably also designed the interior decoration at Luneville and Commercy; as well as 1749 the bridge of Essey over the Meurthe, and 1752 the bridge of S. Vincent over the Moselle. The title of *contrôleur général des domaines et bois* was created and made hereditary for him, with the rank of *conseiller*, 27 April 1751; he was ennobled 15 September 1751 by Stanislas, and received from Louis XV the Order of S. Michael. He published, in illustration of many of the above works, *Recueil des plans, etc., des châteaux, jardins, et dépendances que le roy de Pologne occupe en Lorraine*, 61 pl. fol.; *Recueil des plans, etc., de la place royale de Nancy*, 13 pl. fol., Paris, 1753; and *Recueil des fondations et établissements faits par le roi*, fol., Luneville, 1762. He died 2 (not 3) February 1763 at Luneville. In opposition to the fashion of the day, he abandoned in some of his designs the use of orders embracing two stories in height, and employed terrace-roofs instead of the *comble à la Mansard*, so as to obtain a skyline for his balustraded and richly

decorated parapets. CALMET, *Bibl. Lorraine*, fol., Nancy, 1751, supp. 139; MOREY, *Notice sur la vie et les œuvres*, 8vo., Nancy, 1863 (extracted from the *Mémoires de l'Académie de Stanislas*, 1862), who gives a portrait from the fine engraving which sometimes accompanies one or other of Heré's publications.

HEREFORD. A city situated on the river Wye, in the county of the same name in England, on a stratum of gravel 900 acres in extent and from 15 to 33 ft. deep. Some slight remains of the old walls exist on the western side; a bastion is still standing in Blue School-street; and a portion of an ancient building known by the name of Bridewell, on the south side of the site of the castle, and supposed to have been connected therewith, is now used as a dwelling. The last of the city gates was taken down about the end of the last century. The principal streets are broad and straight, are macadamized, and well lighted with gas; the houses are mostly of brick, and the public buildings of stone. The Castle-green walks were laid out 1746; in the centre is the Nelson column 60 ft. high, carried out 1809 by Wood of Hereford, from a design by T. Hardwick. The river is crossed by three bridges; the Wye bridge, 1490, of six stone arches, is about 240 ft. long, the centre arch was destroyed 1645, but repaired soon afterwards, and about 1828 the roadway was widened: the wrought iron bridge of the Newport railway, 1853, by Messrs. Liddell and Gordon, is of three segmental spans of 82 ft. each, with an occupation arch at each end; the piers in the river are of cast iron filled with concrete; it cost £10,000; with this line is connected the Worcester railway, opened 1860: and the wooden platform or bridge on stone piers for the Ross and Gloucester railway, 1855, by I. K. Brunel, C.E.; with this line is connected the Shrewsbury railway; that to Hay and Brecon was opened later. The Herefordshire and Gloucestershire canal was begun 1791, and continued 1845 from Ledbury, by Messrs. Ballard, C.E. The statue of the late Sir G. Cornwall Lewis was placed opposite the shire hall in November 1864.

The cathedral, dedicated to SS. Mary and Ethelbert, was commenced to be rebuilt about 1030 by bishop Athelstan; it was burnt 1057, and remained a ruin for twenty-four years; a considerable portion of the south transept, the south-east aisle, and the vaulted entrance to the chapter house, are considered by some to be of that date. About 1079 the works were resumed by bishop Robert HERBERT de Losinga, who erected the arches of the choir which were completed by bishop Raynelmus, who erected the nave with the original west front, and the building was consecrated in 1110. The north transept was erected during the latter half of the thirteenth century, and the present central tower and the original west tower cir. 1320. It was formerly surmounted by a timber spire covered with lead 292 ft. high, which was taken down shortly before the year 1800. The pinnacles were added 1827-30. The earlier portions of the north porch were erected cir. 1350; the clearstory of the choir cir. 1250; and the doorway at the south-east corner of the nave leading to the cloisters during the Decorated period; 1327 the Lady chapel, its crypt which was repaired 1497, with the eastern transepts; 1330 the chapter house, an octagon 40 ft. in diameter, and unroofed in 1652; cir. 1400 the large window in the south transept; 1455 Stanbury's chapel, 16 ft. long, 8 ft. wide, and 11 ft. high; 1490 the bishop's cloisters, of which only the east side 109 ft. long, and the south side remain; 1492-6 bishop Audley's chapel on the south side of the Lady chapel; and 1516-35 the exterior of the north porch, a fine example of late Perpendicular work.

The west tower fell 17 April 1786, destroying the whole of the west front, and also a large portion of the nave; James Wyatt, R.A., directed 1788-97 the repairs at a cost of £20,000, when the spire over the central tower was taken down, the west front rebuilt (the nave being shortened one bay, or about 15 ft. in length), the triforium and clearstory rebuilt, the stone groining of the nave destroyed, the pitch of the roof throughout lowered, and the floor raised one foot. During 1841-5

the repairs were conducted by L. N. Cottingham, who rebuilt the east front of the Lady chapel, the eastern gable of the choir, and cut out and reinstated the defective portions of the central tower, at a cost of nearly £27,000; CIVIL ENGINEER *Journal*, iv, 242, 428: his son, N. J. Cottingham, designed 1850-1 the altar screen of Caen stone, which cost £500. He also renewed more or less the piers of the tower, the arches of which are 68 ft. high, the floor of the belfry being 96 ft. from the paving. The stone work props, or "ox-eye masonry" put up about 1712-21 between the arches, were removed, as was likewise the vaulting beneath the tower: the weight of the tower has been calculated at 8,000 tons. During 1858-64 further repairs were undertaken by G. G. Scott, R.A., who has repaired and underpinned the whole of the foundations, and effected an internal and external restoration of nearly the whole building eastward of the tower, and restored the original level of the paving, which has been laid with Godwin's tiles combined with stone; the vaulting of the north transept has also been decorated. In the restorations by J. Wyatt and by L. N. Cottingham, the stone used was from the Shelwick and the Caplar quarry, near Fawley. G. G. Scott has used Caplar stone for the interior, and stone from Three Elms quarry for the exterior. ECCLESIOLOGIST *Journal*, 1849, ix, p. 32; and p. 48, relates the discovery of the foundations of the three eastern circular apses; CIVIL ENGINEER *Journal*, 1842, v, 374-80, gives the paper with illustrations by R. WALLIS, *On the present state of the Cath.*, etc.; BUILDER *Journal*, 1847, v, 502, 517; and xxi, 499, gives the detail of the restorations and cost, by G. G. Scott.

The dimensions are, external length, including the buttresses, 344 ft.; internal length, 325 ft.; nave, 130 ft. long, 38 ft. wide; nave and aisles, 74 ft. wide; great transept, 147 ft. long and 53 ft. wide; smaller transept, 109 ft. long; Lady chapel, 93 ft. long and 30 ft. wide; crypt under it, consisting of nave and aisles, 50 ft. long and 30 ft. wide; nave and choir, 70 ft. high; tower to battlements, 141 ft. high; and to top of pinnacles, 166 ft.; breadth of the tower, interior, 31 ft., exterior, 43 ft. A view of the central tower and north porch is given in the BUILDING NEWS *Journal*, vii, p. 501. The window in the north transept is said to be one of the largest of the Geometric period (*temp.* Edward I.) in this country, the glass being 48 ft. 6 ins. high and 21 ft. 6 ins. wide.

The brass lectern, designed by N. J. Cottingham, was shewn in the International Exhibition of 1851; and the metal screen, by Skidmore and Co. of Coventry, in that of 1862; BUILDER *Journal*, xx, 329. The font, supposed to date about 1160, is nearly 3 ft. in diameter, the stone sides being 4 ins. thick, and curiously carved with figures of the apostles; the fine toned organ by R. Harris, 1686, was rebuilt and enlarged, 1864, by Gray and Davison, at a cost of £1,300; an oak chair of Norman work is said to have been used, 1142, by king Stephen; the bishop's throne dates early in the fifteenth century. Among the few remaining tombs is that of bishop Losinga, who holds in his hand a model of a tower; also the effigies of eight other Norman bishops; the tomb of bishop Braose, 1215, who also holds a model of a tower in his hand; that of bishop Aquablanca, who died 1269; the celebrated shrine of bishop Cantilupe, ob. 1283, erected 1319; and the tomb of bishop Booth, erected under his own inspection two years before his death in 1535, which still retains the original ironwork. Those in the Lady chapel, and that of Sir R. Pembridge in the nave, *temp.* Richard II., are among the most interesting. The brasses comprise that of dean Harold, 1393; Richard de la Marr, 1435, and Isabella his wife, 1421; dean Frowcester, 1429; bishop Trelleck, 1361; and Sir Richard Delabere, 1513, his two wives and twenty-one children: there are also numerous fragments of brasses affixed to the walls.

Adjoining the south side of the bishop's cloister is a fragment of a chapel pulled down 1737, which was attributed by some to the Roman period; this building is engraved in the

VETUSTA MONUMENTA, 1738: it was the parochial chapel of S. Mary Magdalen, now merged into S. John's parish, the vicar of which receives a pension from the bishop as vicar of that chapel. The cathedral college, 1474, was destroyed by fire in 1838; it is a quadrangle, having the hall on the south side; the bishop's palace was much improved 1815-33; the deanery is a plain modern building.

The present churches, situated at the terminations of the principal streets, are S. Martin, Ross-road, by — Jeppard, consecrated 1845, cost £5,000; S. Peter, founded 1070, partly rebuilt 1793, with a spire 160 ft. high; S. Nicholas, opened 1842, cost £4,000; and All Saints with a spire 225 ft. high. The Roman Catholic church of S. Francis Xavier, Broad-street, 1838, cost about £30,000, was designed by — Day; S. Michael, Roman Catholic cathedral, and Benedictine priory for forty men with school and chapel attached, at Belmont, two miles from Bath, designed by E. W. Pugin, was commenced 1857 and opened 22 Nov. 1859, the church costing £14,000, and the priory £10,000; the dimensions are 113 ft. from east to west, nave 47 ft. long by 37 ft. high, transept 61 ft. long: the exterior of the cathedral is built of Lugwardine coursed stone, with Forest of Dean stone dressings, and the interior of Caen, Painswick, and Bath stones; the vaulting of the tower is groined in Caen stone, with Devonshire marble columns; the other buildings are built with random coursed local stone with Bath stone dressings; *BUILDING NEWS Journal*, v, 184, 1094; *BUILDER Journal*, xvii, 193; xviii, 662. The house at Belmont, of Bath stone, designed 1788 by J. Wyatt, is the seat of F. R. Wegg Prosser, esq., at whose expense the above buildings, except the monastery, have been erected.

The town hall, a modernised relic of the one said to have been erected by John Abel (ob. 1674), was sold for £200 in March 1861, and pulled down; a sketch of the upper portion is given in *BUILDER Journal*, xviii, 467, 592; a view, with some details of the columns, in *CIVIL ENGINEER Journal*, i, p. 164; and a view of the supposed original structure in CLAYTON, *Ancient Timber Edifices*, fol., London, 1846, who also gives the house in Butchers'-row, 1621; and the almshouses in Berrington-street, as also by Abel. The county gaol, 1797, by John Nash, has a Grecian Doric portico of six columns in front, and cost £18,646; the shire hall, opened 1817 or 19, by Sir R. Smirke, R.A., cost £30,000, it contains the two law courts, each 46 ft. long, 39 ft. wide, and 26 ft. high; and the county hall 70 ft. long, 48 ft. wide, and 36 ft. high, which will accommodate 2,000 persons: the union workhouse was erected in 1837; the post-office, 1853, is by — Cranstone; the corn exchange by W. Startin, completed 1858, cost £2,306, the large room is 72 ft. long, 46 ft. 6 ins. wide, by 34 ft. high. The offices for the local 'Times' newspaper, 1859, by James Williams, has dressings of Bath stone; the general infirmary, 1775, is by W. Parker; the market gateway and clock tower, 1861-2, by the late J. Clayton, who also designed, 1860, the new poultry and butchers' markets, hop and wool warehouses, and the new sessions room, at a cost of upwards of £4,650. The assembly rooms attached to the Green Dragon hotel, 1857, are 64 ft. long, 26 ft. wide, and about 30 ft. high; the drainage water works and cattle market, the latter covering nearly four acres, were contracted for in 1855 by W. Moxon of Dover for £22,000; the city reservoir, 1856, by T. Curley, C.E., cost £13,000.

The remains of the Black Friars monastery are preserved in the garden of the Red Coat or Coningsby's hospital, built 1625 on the site of the commandery of the Knights of S. John; adjoining the hospital is the lower portion of the pulpit or preaching cross, cir. 1350, of a hexagon form, open on each side, raised on steps, with a pillar of the same shape in the centre; it was repaired and completely renovated 1864: S. Ethelbert's hospital, founded 1290, was rebuilt 1805: S. Giles's hospital, founded 1290, was rebuilt 1770: Williams's hospital, founded 1601, was rebuilt 1675, and the front again in 1809. Neither the school buildings nor the other charitable edifices deserve

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attention except S. Giles's hospital almshouses, where, in an ancient pediment, is built for preservation a curious carving, formerly appertaining to a monastic building of the Gray Friars on the site on which these houses are erected.

The White Cross, 1361-9, on the site of the plague market, about one mile from the city, consisted of an hexagonal shaft, 6 ft. in height, the sides being 2 ft. wide each, standing on a series of seven steps, 11 ins. wide and 12 ins. high, 10 ft. long at the base, and surmounted by an embattled parapet and with the molded base of a second division of the shaft; this erection was repaired 1850; the height is now 15 ft.; a Maltese cross with shaft has been added 1864.

JONES, JUN., *Hereford Guide*, 8vo., Hereford, 1858; REES, *Hereford Guide*, 2nd edit., 12mo., Hereford, 1808 (Longman and Co.), and edit. 1827; BRITTON, *Cath. Antiq.*, 4to., London, 1835; PRICE, *Hist. Account of the City*, 8vo., 1796; WINKLE, *English Cathedrals*, 8vo., 1836-42; STORER and GREIG, *Cath. Churches of Great Britain*, 8vo., 1814-9; COOKE, *Topographical Guide*; JOHNSON, *Customs of Hereford*; DUNCUMB, *Hist. of Herefordshire*, 4to., Hereford, 1804; RAWLINSON, *Cath. Antiq.*; HAVERGAL, *Visitor's Handguide*, 1864; MURRAY, *Handbook of Cathedrals* (western division), 8vo., 1864. T. N.

HEREFORD (ATHELSTAN or ETHELSTAN OF), bishop of Hereford 1012-56, began cir. 1030 building his cathedral from the foundations; the words "in ecclesia quam ipse construxerat a fundamentis", describing the place where he was buried on his death 10 February 1056, having been blind for thirteen years previously. GULL DE MALMS., and HOVENEN, *De Gestis Pontif.* post Bedam, fol., Frankfurt, 1601, p. 444.

HEREFORD (WALTER DE), master mason at the castle at Carnarvon, petitioned in 1304, 33 Edward I, for payment of 130 li. vis. q. for works done there by him for the king; *Rolls of Parliament*, fol., London, n. d., i, 167 b. He was probably succeeded by H. ELLERTON.

HERETIERA MINOR, or *Soondra*, a wood of Tenasserim very tough and elastic, commonly used for boat building, etc.; but it is a very perishable wood and shrinks a good deal in seasoning. From Major H. Campbell's valuable experiments on the strength of Indian timber, out of twenty-seven woods examined, the Soondra was found to be the strongest. 71.

HERFAST or ARFAST, see THETFORD (ARFAST OF).

HERION, properly ERION, see TUMULUS.

HERIOT. In copyhold law, a rendering to the lord of the manor the best beast, or the best chattel, or some other stipulated article, or a sum of money in lieu thereof on every change of a tenant on the roll by death or alienation, or on death only, as the case may be, according to the custom of the manor. This is supposed to be derived from the old feudal usage when the lord furnished the vassal with a horse and armour to go out and fight in his cause when required, and naturally wished to resume on the death of the tenant.

The customs vary in every manor. In some the best beast or chattel in the possession of the tenant, wherever it may be, is liable to be seized. In others only the best beast or chattel on the copyhold land in question. In this last instance, in case of the illness of the copyhold tenant, the best beast (as was the case of a famous race-horse) has been removed from the premises and another beast substituted. In the former instance, it is the custom to find and mark the best beast, that there may be no exchange or substitution. An example where the best chattel was the heriot, occurred to the late Sir Robert Peel. He had purchased an insignificant piece of copyhold, and it was found that, in case of his death, the fine picture by Rubens belonging to him, and valued at £10,000, would have been sequestrated to the lord of the manor as a heriot.

The valuation of the enfranchisement of heriots is one of extreme difficulty, as may be judged from the foregoing. In the first place, it depends on whether it be payable on death only, or on death and alienation. The commissioners, however, recommend to take the averages of the last three payments,

and to charge two heriots in the former case, and two and a half in the latter. The whole system is now out of date, and requires the supervision of the legislature. COPYHOLD; ENFRANCHISEMENT. A. A.

HERITAGE (THOMAS) A.M., was chaplain to king Henry VIII, and surveyor of his works at Westminster. He was presented 11 April 1513 to Brington church by Sir J. Spencer, knight, in whose will, dated 12 April 1522, two days before his death, it is affirmed that he had almost rebuilt the parish church, which would include the north chapel, chancel, and clearstory of the nave, and therefore it is assumed this was done from the design, and under the superintendence, of Heritage; *Churches of Northamptonshire*, 8vo., London, 1849, p. 260.

HERKOS, see HERCOS.

HERLEBECHERIA. "To build a certain *herlebecheria* beside the great kitchen at Clarendon, July 9," is noticed in TURNER, *Dom. Arch.*, 8vo., Oxford, 1851, i, 240, from the Liberate Roll, 36 Henry III.

HERLEWIN or HARLEWIN, a monk of Caen, afterwards abbot of Glastonbury 1097 or 1101, expended 480 pounds (libras) on the abbey church which he rebuilt, and of which no remains now exist. He died in 1120. GUL. MALMS., i, 117-8, quoted in DUGDALE, *Mon. Angl.*, fol., London, edit., 1817, i, 4; GALE, *Antiq. Glast.*, fol., London, 1691, iii, 333.

HERMANNSTADT (Hungarian, *Nagy-Szeben*). A chief town in Transylvania, and situate on the river Cibin or Ziblin. It was founded 1101-3 by a Hermann of Nürnberg; and consists of a high and a low town, and three suburbs. The two former are surrounded by double walls flanked with towers and bastions and enclosed by ditches, all in a very dilapidated state; the high town is well built, and contains several good squares and well paved clean streets. A succession of steep stone stairs lead down to the lower town, which is ill built, unpaved, and dirty. The principal buildings are the Lutheran cathedral, built 1357-1460, 300 ft. long, 60 ft. wide, and 48 ft. high, with a lofty tower 228 ft. high; the Roman Catholic church, 120 ft. long and 60 ft. wide; the new Reformed church, 1788, 84 ft. long and 42 ft. wide; the protestant gymnasium; the Brückenthal museum containing several good collections, a room with 18,000 medals, and a library of about 15,000 volumes; the town house, an old mediæval structure; the theatre; the barracks; the house of correction; and an orphan and other hospitals. The national Universität or States meeting is held in the town, which is also the seat of a military governor, and of several important courts and public offices. 26. 50.

HERMES, see TERMINAL.

HERM GRANITE, see GRANITE, p. 72.

HERMITAGE (It. *eremitaggio*, *eremo*, *romitorio*; Sp. *eremitorio*, *ermila*, *ermitorio*; Fr. *ermitage*, *hermitage*; Ger. *einsiedelei*). The name given to the habitation in a lonely situation, of a person leading a solitary life, i. e., of an hermit (Gr. *ἐρημίτης*); but extended to a religious establishment, similarly situated, for two or more persons. LAURA. When the reputation of the recluse or recluses was considerable, the hermitage was sometimes the object of an endowment; and a monastic community would naturally be formed near it; so that ultimately the place became no longer lonely. In other cases of dependance upon a monastery the hermitage seems to have been founded as a place of greater inconvenience than the parent institution. A cell occupied in a similar manner, but situated in a less lonely spot, as in a church, over a church porch, in a churchyard, or in a town-gate, was known as an ANCHORETAGE or ANCHORIDGE. The original solitary abode is supposed to have been at once a dwelling and an oratory; but a division was thought to be desirable; and ultimately the cell and the chapel became distinct. Hence arose the hermitage-chapel, such as the small oratory with a wooden roof, or with a vault, having a belfry or a bell-gable, which still remains in considerable number on the Continent, especially

in France, where curious plans of such edifices occur, as in that at Planès, given s. v. *Chapelle*, by VIOLETT LE DUC, *Dict.*, p. 443; and that of S. Michel at Puy-en-Velay. Views are given by NODIER and TAYLOR, *Voy. Pitt.* (Languedoc), fol., Paris, 1835, in the marginal illustrations to vol. ii, part 1, sheets 46-62, of those of N. D. del Coll, N. D. de Tanya, Ste. Catherine près Baixas, S. Fereol, La Trinité, La Consolation, and Planès; with pl. 176-7, that called Las Casas de Penna. A rival to the latter is the sanctuary of S. Romedio, near Cles in the Tyrol, which is placed upon a rock so that it can only be approached by a stepped path passing through four successive chapels. TAYLOR, *Index Monast.*, fol., London, 1821, xv, gives, p. 65, a list of about seventy hermitages and anchorages or anchorages in Norfolk. The mimicry of a hermitage in a park has been noticed s. v. GROTO.

HERMON (Gr. *Ἡρμων*), son of Pyrrhus and brother of Locrates, the three oldest Greek architects, constructed for the Epidamnians an edifice called the treasury at Olympia, in which Theocles placed two statues of cedar wood. PAUSANIAS, vi, 19, 8. 3. 62. 117.

HERMOCREON (Gr. *Ἡρμοκρέων*) at an uncertain period but anterior to the Christian era, designed at Parium on the Propontis, the altar, one stadium in length on each side, which was erected when the neighbouring town of Adrasteia was abandoned and its oracle of Apollo and Artemis destroyed: STRABO, xii, 487, xiii, 586. 112. 116 117.

HERMODORUS (Gr. *Ἡρμόδορος*) of Salamis, built at Rome in the Circus Flaminius (or rather in its *prata* or precincts), a temple to Mars, which was ordered by Decimus Junius Brutus Callaicus or Gallacius, in memory of the successful campaign in Spain in the year 136 B.C., and which received the statue by Skopas: CORNELIUS NEPOS, Fr. 11, in PRISCIAN, *Libri Omnes*, 8vo., Venice, 1527, viii, p. 93; PLINY, xxxvi, 4. The remains of pillars discovered 1837 in the *via degli speechi*, probably belong to this pycnostylar temple: INSTITUTO DI CORR. ARCH., *Annali*, 8vo., Rome, 1838, x, 5; PLATNER, *Beschreibung der Stadt Roms*, 8vo., Stuttgart, 1830-2, iii, 3, p. 29.

Should a speech delivered, B.C. 99, by Marcus Antonius, "de navalium opere", superintended by a Hermodorus, CICERO, *de Orat.*, i, 14, refer to the same artist, his life would then have been far more widely extended than has been supposed, and it might be inferred that he constructed also some port or waterworks at Rome, of which no records are left.

Because the portico of Metellus Macedonicus, called afterwards of Octavia, was constructed B. C. 148-130, between his triumph over Andronicus and the forfeiture of his property to the republic, the construction of a temple to Jupiter in that portico might have taken place about the same time as that of the temple to Mars above named. According to the Capitoline plan, this temple of Jupiter was not perfectly peripteral, for the back pillars are wanting; a circumstance which is not mentioned by VITRUVIUS, although immediately afterwards he notices it as the case at the temple to Honour and Virtue. This however may be explained, as at the time of Augustus the whole area had undergone great changes, and the primitive form of the temple might have been modified. Influenced by such a coincidence of place and time, and by the fact that some editions of VITRUVIUS, iii, 1, read "ambulationem circa cellam ædis quemadmodum in porticu metelli jovis statoris hermodi et ad mariana honoris et virtutis sine postico a mutio facta," TURNER suggested that *Hermodi* was a mistake for *Hermodori*, and inferred that the subject of this notice was thus recorded by VITRUVIUS as the architect of that temple to Jupiter. On the contrary, this use of the genitive case is not usual in the author, and if *templum* be understood, all the works noticed in the passage quoted might be attributed to Mutius; SCHNEIDER preferred the word *hujusmodi* that occurs in several manuscripts; e. g. at full in the Arundel MS. 122, and contracted to 'h,modi' and 'h'modi' respectively in the

Harleian MSS. 4870 and 2760, which last indicates the cause of the error, as *h'* is clearly meant for 'hujus' in neighbouring passages. 117.

HERMOGENES (Gr. *ἑρμογενής*) of Alabanda, lived at a period uncertain, but apparently to be placed between the erection of the Parthenon, *n. c.* 453, and the Mausoleum, *n. c.* 363. To him VITRUVIUS, *iv*, 3, *vii*, *pref.*, attributes the octastyle eustyle monopteral (really dipteral) temple to Dionysus at Teos; and records, *iii*, 2, that Hermogenes invented the eustyle proportion; and *vii*, *pref.*, that he left a treatise on that building. The same authority, *iii*, 1, attributes to him the erection of the octastylar pseudodipteral temple to Artemis Leukophryene at Magnesia; and *vii*, *pref.*, says that he also left a treatise on that structure. But *iii*, 2, he attributes to Hermogenes the invention of the octastylar or pseudodipteral formation: whereas LEAKE, *Asia Minor*, 8vo., London, 1824, 350, notices that at Selinus the remains which are much more ancient than the time of Hermogenes, prove that the great temple to Jupiter as well as one of the hexastyle temples, was constructed on pseudodipteral principles. VITRUVIUS, *iv*, 3, notices that some ancient authors asserted that sacred buildings ought not to be constructed of the Doric Order, because false and incongruous arrangements arise in the use of it: that such was the opinion of P'archesius, Pitheus, and Hermogenes; and that the latter, after having prepared at Teos the marble for a Doric temple to Bacchus, changed his mind and made it of the Ionic Order. The skill and ingenuity with which Hermogenes designed his works are applauded by VITRUVIUS, *iii*, 2, who thinks that these cannot but be acknowledged as the sources from which his successors derived their principles. 116. 117.

HERMOLYCUS (Gr. *ἑρμολυκος*). This name, in the genitive case, was discovered on the back of the capital of a pilaster at Telmissus by CLARKE, *Travels*, 4to., London, 1812, 2, *i*, 241, whose inference that it is the name of the architect has been adopted, whereas it may only be that of the workman of the single ornament in question.

HERMONTIS. A city in the Upper Thebaid of Egypt, now represented by the village of Erment. The ruins formerly shewed the remains of a Christian church about 190 ft. long and 85 ft. wide, with internal columns; the substructions of a large temple; and the mammeisi of Reto, wife of Mandoo, in pregnancy of Horprie, built to celebrate the birth of Ptolemy Caesarion in the reign of the last Cleopatra (*b. c.* 44-29), which last building seems to have been destroyed about 1845. The *Description de l'Égypte* (Antiquités), *texte* *i*, 409-442, *pl.* *i*, 91-7, gives a plan of the site, with views, elevations, and sections. 28.

HERMOPOLIS MAGNA (Coptic *Shmoun*). A city now represented by the village of Achmounein, Eshmoom, or Oshmoanein in Egypt. The *Descr. de l'Égypte* (Antiquités), *texte* *iv*, 159-97, *pl.* *iv*, 50-2, gives a plan of the site; with a plan, elevation, section and view of the temple to Thoth or Hermes, which was inscribed with the names of Philip Aridaeus and of Alexander IV, *b. c.* 323-317; but about 1825 this building was destroyed in order to turn the calcareous stone into lime. The columns, 40 ft. high and 8 ft. 6 ins. in diameter, were like those at Gorneh composed of irregular pieces, not of frustra. The brilliant colouring of this edifice is preserved in MINUTOLI, *Reise*, Berlin, 1824, *pl.* 14. At the base of the neighbouring western hills is the *ibœum* or burying place of the birds sacred at Hermopolis, and near to it is Gebel-Toona, with a *stèle* inscribed with the name of the king Atin Re Bakhan. The grottoes of BENI-HASSAN were the necropolis of this city. 28.

HERMOSILLA Y SANDOVAL (JOSÉF), born at Llerena in Spain, was a captain in the Royal Corps of Engineers. Having studied at Seville and Madrid, he was sent to Rome by Carvajal the minister of state. On his return he was appointed professor of architecture in the academy of S. Ferdinando, of which he became shortly afterwards director; and at the same time principal deputy to the chief architect of the court. He

directed the academy until 28 Oct. 1756, when he resigned in order to rejoin his corps, remaining however an honorary member. The academy having resolved to collect documents of the ancient buildings at Granada, Cordoba, etc., and having directed 1764 D. Sanchez Sarabia to make the drawings, Hermosilla was appointed one of the committee to prepare them for publication, and they were subsequently engraved. He was afterwards appointed with other engineers to make drawings of the Escorial. His translation of the work of VITRUVIUS does not appear to have been printed; and he wrote during his stay at Rome a treatise on geometry and machines employed in building. He made the campaign of 1767 in Portugal, and was afterwards commissioned to survey the line of part of the frontier. He designed the rebuilding of the old *colegio mayor* of S. Bartolomé, with its staircase and two-storied cloister, at Salamanca; and at Madrid, the *retablo* of the sacristy in the church of the Trinitarios calzados; and the *hospital-general*; and laid out the *Prado*. He died 21 July 1776, holding the rank of captain. 66.

HERNANDEZ (BARTOLOMÉ) was resident architect (*aparejador*) of the works 1585 at the Escorial in Spain. 66.

HERNANDEZ (CLEMENTE), constructed 1627 together with P. de Riosco and B. de Naveda, the principal cloister of the convent de la Merced calzada at Madrid; it was quadrangular, of stone, with pilasters on the buttresses of the inner arches. "These undertakers were paid seven reals de vellon per foot of the work; from which it might be inferred that they were merely masons (*canteros*); but they, as well as many others, deserve to be ranked amongst architects, as they themselves drew the plans and executed the works." 66.

HERNANDEZ or FERNANDEZ (DIEGO) of Seville, was 1545 one of the members of the committee appointed to select the best plan for the proposed hospital de la Sangre, submitted to competition. GAINZA. 66.

HERNANDEZ (SEBASTIAN), was master of the works at the church of S. Martin at Madrid, which was begun by G. Ordoñez 1590-1611; and the cupola designed by Lorenzo de S. Nicolas; it was destroyed by the French in 1809. He designed many other buildings. He died 24 January 1639, and was buried in the parish church of S. Justo. 66.

HERODEIUM. The top, 250 ft. diameter, of a steep round hill about 350 ft. high, about seven miles and a half from Jerusalem, is enclosed by walls of large hewn stones, with remains of a large round tower at each of the cardinal points; that to the east is not so much destroyed as the rest, and in it a magazine or cistern may be seen; traces of terraces appear round the bottom of the hill; ROBINSON, *Biblical Researches*, 8vo., London, 1856, *i*, 478-81. This is the fortress with round towers having in it apartments of great strength and splendour, constructed by Herod the Great, according to JOSEPHUS, *Ant.*, *xv*, 9; *Bell. Jud.*, *i*, 21.

HEROUM (Gr. *τὸ ἥρῶν ἱερὸν* also called *ναῖδρον*). The distinctive term applied by the Greeks to the small buildings which were erected in the form of a shrine or a temple over graves: one is mentioned by HERODOTUS, *Terp.*, 47, as erected by the Egæstæans to the memory of Philip, son of Butacidas: Here must have been an altar, for the author says they propitiated the departed hero with sacrifices. LIDDELL and SCOTT, *sub voce*, referring to this passage, say, such as the heracleion. THUCYDIDES, *ii*, 17, speaks of "the temples and heroa at Athens." SUIDAS and HESYCHIUS simply render the word *μνημεῖον*. An example of importance is the tomb of Cyrus at Pasargadæ, given in FLANDIN, *Perse Ancienne*, fol., Paris, 1851, p. 194-6. The Latins generally use *delubrum* or *sacellum* for such erections; though CICERO, *De Legibus*, *ii*, 61, has the word heroum. The name was given to the imperial burying-place, in the church of the Apostles at Constantinople, destroyed 1230-68 by the western conquerors; it is now frequently used to denote a rich monument, as the heroum of Empedocles on the acropolis at Selinus; the heroum at

Xanthus, etc.; and by SMITH, *Dict.*, s. v. Funus, to denote not only any tomb built in the form of a temple, but even any *stèle* decorated like the front of such a building.

A. A.

HERRADA (BARTOLOMÉ DE), see DIAZ DE PALACIOS (PEDRO).

HERRERA (BUSTAMANTE DE), of Spain, was with three Germans, in 1543 commissioned by the government to survey the grounds for the canal of Campos; the report is preserved in the royal archives of Simancas. In 1551 he was appointed by letters patent to inspect all the royal works in course of construction at Toledo, Seville, Granada, Madrid, Pardo, and Aranjuez, and to report upon their progress. 66.

HERRERA (FRA ANTONIO DE), born 1582, son of the celebrated Juan de Herrera, studied and practised under his father, and is said to have been employed on the Escorial; but having committed murder, he obtained, through the intercession of his father, a pardon from king Philip II, on condition of quitting the country; he went to the Philippines about the end of the sixteenth century, and having taken the habit of a monk, he entered the order of the Ermitaños Observantes of S. Agustín at Manila, as a lay brother, and designed their monastery and church, which were commenced 1599, and, according to GASPAR, *Conquistas de las Philipinas*, fol. Madrid, 1698, form one of the best edifices of the place; MURILLO, *Geografía*; and MORGÁ, *Sucesos de las Islas Filipinas*, 4to., Ant., 1609, also praise the building. 66.

HERRERA (JUAN DE) practised 1512-24, as resident architect (*aparejador*) of the cathedral at Seville. The time of his death is not recorded. 66.

Another JUAN DE HERRERA was resident architect (*aparejador*) at the palace at Madrid, and was appointed 1609 to measure the works executed by G. Ordoñez at the church and monastery of the Trinitarios calzados. He died 31 Sept. 1627, and was buried in the church of S. Martín. 66.

HERRERA (JUAN DE GUTIERREZ DE MALIAÑO DE), one of the most distinguished architects of Spain, was born in or about the year 1530 at Mobellan in the Asturias de Santillana. He went in the suite of prince Philip to Belgium, where 1548-51 he studied architecture; 1553 to Italy as a soldier; accompanied his general Gonzaga to Flanders; and 1556-8 remained at Yuste with king Charles V. His copy 1562 of the diagrams to a manuscript written 1252-84, procured his appointment, with a salary of 100 ducats, as an assistant to Juan Bautista de Toledo, who was engaged at that time in the construction of the Escorial (first stone laid 23 April 1563): his appointment was approved 18 Feb. 1563 by king Philip II; and he succeeded his master, who died 19 May 1567. The king not only entrusted him with the construction of numerous edifices, but commanded that the designs for every public building of importance should be submitted for his approval; and with the assistance of the resident architects here named in connection with the several works, he took the direction 1567 of the royal buildings, at a yearly salary of 250 ducats (£83), increased 1569 to 400, 1577 to 800, and 1587 to 1000 ducats, besides being made 1579 *apostentador* with 250 more, which place he retained until his death.

To Herrera is due the credit of having at the Escorial accommodated a hundred instead of fifty monks by altering the elevations to uniformity, without making any change in the plans; he began the foundations 1574, of its church of S. Lorenzo (L. de Escalante, P. de Tolosa, J. de Minjares, and B. Hernandez), which was completed 1587; the monastery was continued under F. de Mora: 1571-84, he made several plans for the palace at Aranjuez, turning the chapel begun by J. B. de Toledo into a pavilion of the south side of the new palace (G. Gili, A. de Vergara, J. de Minjares, L. de Escalante, and B. Ruiz, until 1586); the work was finished 1752 on the north side on the original design, except the entrance by S. Bonavia; and designing the *casa de oficios* with the porticoes which enclose it and unite it with the palace; this was finished by J. Gomez

de Mora, who copied it in the *casa de caballeros*; MILIZIA gives a long description of this palace: he designed 1571 several works at Toledo, especially the southern façade of the palace (G. Gili, D. de Alcantara, and J. B. Monegro); and also the Franciscan convent and church at S. Domingo de la Calzada: 1572, at Segovia, the retablo of the capilla mayor of the monastery of Sta. Cruz: 1574-83, the alterations for the royal archives at Simancas (F. and J. de Salamanca, and P. de Mazuecos): 1572, the bridge over the Guadarrama, between Galapaga and Torrelodones: 1583, the great retablo for the monastery of Yuste: 1584, the bridge of Segovia over the Manzaranes at Madrid; the choir of the nunnery of S. Domingo el Real at Madrid; the church of Valdemorillo, near the Escorial; the church at Colmenar de Oreja; the entrance to the castle of Villaviciosa for the count de Chinchon: 1585, the cathedral at Valladolid: 1585-6, the exchange (*lonja*) at Seville, which occupies a site about 200 ft. square (J. de Minjares 1585-98), receiving 1000 ducats as his fee: 1587, the church of Sta. Quiteria at Alcazar de S. Juan: 1589, the royal lodging at Torrelodones: and 1596, the plazuela Zocodover at Toledo.

He was consulted 1564 on the works of the monastery of S. Jago at Uclés near Cuenca (called Veles in MILIZIA), but only the north and west sides appear to have been varied by him from the design of G. de Vega: 1577, on the works to be done by J. A. Rodi in building the cathedral at Cuenca: 1577-97, on those by J. de Valencia and F. de Mora at the alcazar of Madrid; on the royal houses called the Campo and the Pardo, including at the latter place the *casa de oficios*: 1584-7, on the façade of the cancelleria of the palacio de la audiencia at Granada (M. Diaz Navarro and A. Hernandez): 1586, on the college and church called Corpus Christi at Valencia: 1586, at Seville, on the custom house, the mint, and the Triana gate; at Lisbon, on the tower added to the palace; and the mansion built there by the marquis of Castel Rodrigo: 1588, on the progress of the cathedral at Salamanca; and on the bridge over the Guadiana at Badajoz. The house of D. de Vargas at Esteban de Ambran, and the parish church of Villacastin, are attributed to him, as well as two portals of the church at Segovia; 1571, the gate called the *Puente* at Cordoba; and 1579-94, the great *barrage* or dam of Alicante.

He contrived a crane, on an improved principle, to facilitate the works at the Escorial; and with the same end, he caused the stones to be dressed at the quarry, which was opposed but afterwards followed by the masons. His original drawings and those by de Toledo for the Escorial, long remained in the king's cabinet in the alcazar at Madrid; many of them were rescued from the conflagration in 1734, and, becoming dispersed, were offered for sale later in the century. He published eleven geometric drawings, engraved in 1587 by Pedro Perret, with the title *Sumario y breve declaració de los diseños y estampas de la Fabrica de San Lorenzo el Real del Escorial*, 8vo., Madrid, 1589; one of the three known copies is in the British Museum. His portrait in an allegorical subject by Otto Venius engraved by Perret is now a rare print; and J. Trezzo engraved 1578 a medal in his honour. In consequence of his failing health, the drawings for all works done after 1587 at Segovia, 1589 at the Escorial, and 1591 at Madrid, were made by F. da Mora for Herrera, who 1593 resigned the Escorial, and died 15 January 1597 at Madrid, where he was buried in the Sotomayor chapel in the church of S. Nicolas, where the register described him as *trazador mayor y apostentador* (draughtsman in chief and chamberlain), though he describes himself simply as *apostentador mayor* in his Will, printed among documents relating to him and occupying one hundred pages of LLAGUNO.

Herrera was undoubtedly the originator of the architectural academy founded by Philip II, which followed with more or less success the path opened by him; but, eventually, the *stilo Herreresco* succumbed to the *stilo Churriguresco*. Most biographical works have neglected to notice this eminent

Spanish architect. CAVEDA, *Ensayo historico—de Arquitectura en Espana*, 8vo., Madrid, 1848; transl. by HEYSE and KUGLER, *Geschichte der Baukunst in Spanien*, 8vo., Stuttgart, 1858. 65. 66.

HERRERA HINESTROSA (FRANCESCO DE), born 1622 at Seville, was the second son of F. de Herrera, a painter. Having studied architecture at Rome, he returned to Seville 1656, and went to Madrid 1661, where he was appointed 25 August 1677 *maestro mayor* of the royal works, in which capacity in 1677 he was sent by king Charles II to Zaragoza to select the site for the cathedral del Pilar; his designs for which were approved, and the foundations commenced immediately; the description of it is given in LLAGUNO. In 1680 he made the surveys for the canal of Jarama near Aranjuez. According to PALOMINO he was the first to introduce into Spain the "manera Borrominesca". He was also an oil and fresco painter, and was appointed by Philip IV principal painter, and by Charles II superintendent of the pictures and chief architect. He died 25 August 1685 aged 63 years, and was buried in the church of S. Pedro at Madrid. 5. 65. 66. 113.

HERRING BONE, see STRUTTING; and DWANG.

HERRING BONE OR DIAGONAL BOND. A mode of building very thick brick walls, where the bricks in the interior are laid obliquely or at an angle of about 45° with the face of the wall, the direction of each course being reversed alternately so that they cross each other: the exterior or casing is laid in the usual manner; it is doubtful if any good result is obtained by this manner of building; DEMPSEY, *Builder's Guide*, 8vo., London, 1851, p. 59.

A two brick wall is the thinnest in which diagonal courses can be used, combined with English bond, and in this case only in the stretching courses, which should have a course of bond over, and then another the reverse way. The triangular spaces at the extremities of the diagonal bricks must be filled in with bats or fragments cut to the same form; and should not be stuffed up with mortar. Sometimes the end of a brick is cut to the shape required (fig. 3). The use of diagonal courses consists in producing a more powerful bond than the lap of a quarter brick only, and in there being no possible way of laying the diagonal bricks wrong; for if they be intermixed with common English bond as stated, one, two, three or more whole bricks, laid diagonally, will just fill up the core of a wall, in proportion to its thickness, and all the successive courses of those bricks will break joint properly, whether in reference to each other, or to the common courses of English bond above or below them. Fig. 1 shows a 3½ brick wall; and fig. 2 a 2 brick wall. Upon the whole, common English bond intermixed with occasional courses of diagonal or herring bone bond, whenever the walls are thick enough to admit of it, is by far the strongest and best combination of bricks that can possibly be adopted. These diagonal courses were used throughout the whole height of the thick brick walls backing the stone work of the original front of the Custom House, London. In one of the walls the courses were in alternate single courses of common and diagonal bond, and it was remarked that the lower part which appeared to have been grouted, seemed stronger than the upper part built with mortar only, the arrangement of the brick courses being alike in both. The new walls also in the same building have occasional courses of diagonal bond: PASLEY, *Outline of Course*, etc., 4to., Chatham, (Lith.) 1826, p. 77-9. DIAMICTON.

HERRING BONE WORK (Lat. *opus spicatum*; Fr. *arrête de poisson*). Work formed of bricks or long flat stones set on end in a slanting direction and not upright. Sometimes they are laid head to head, in other cases a horizontal course of

stone is laid between each slanting course. In this latter mode the work exactly resembles the skeleton of the backbone and ribs of a fish. The apparent object is to obtain as few horizontal courses of mortar as possible. Such work is often found in early constructions; particularly in castles—those of Guildford, Colchester and Tamworth being examples. It is sometimes used in brick houses of the Tudor periods as a species of ornament, but



very rarely. The illustration from S. Leonard's tower near Malling Abbey, Kent, is supposed to date 1070-80, and is an early specimen of such work; as given by PARKER, *Buildings of Gundredph*, in GENTLEMAN'S MAGAZINE, 1863. A. A.

Another example of early work of this character in the crypt in the cathedral at York, is given by the Royal Institute of British Architects, *Transactions*, 4to., London, 1836, p. 105.

In some parts of the country different fancies of hewn stone are indulged, of which herring bone is one, consisting of parallel zigzag lines. A specification from Thirsk in 1861 described the stones of a cottage to be "mabbled or herring boned scaffolded; the door jambs, windows and chimnies to be dressed with tool and mallet."

Bricks placed diagonal wise, are also called "bricks spicated" (Fr. *briques en épi*), "after the manner of Hungarian point; such is the pavement of Venice." 13. 25.

HERRING BONE PAVING is generally made of bricks laid flat diagonally, so that the head of one butts exactly on half the side of the other. The work is more pleasing to the eye than that in parallel courses. It is however not so durable as brick on edge. A. A.

HERRMANN, born at Tachau in Bohemia, was prior of the Carmelite monastery of Maria-Schnee in the neustadt at Prague 1347. He drew the plans for the church of his priory and directed its construction; but it is not known whether he lived to see its completion in 1397. BEZCKOWSKY, *Böhmische Geschichte*, ii, 142. 20. 68.

HERSE or HERCE, see HEARSE.

HERSTORFER (HANS), *baumeister*, was employed on the construction of the Stephankirche at Vienna about 1643. 26.

HERTAULT, see HURTAULT (MAXIMILIAN JOSEPH).

HERTIER, see HEURTIER (JEAN FRANÇOIS).

HERTLEYE, HERTLYE or HERTLIF (JOHN DE), warden of the cell of Filchestowe, was elected prior of Rochester cathedral (as John the Seventh) 6 Aug. 1361, and resigned 6 Nov. 1380. During 1367-70, 41-4 Edward III, he was 'capitalis magistri operacionum regis' at Rochester castle; the Roll of accounts, 41 and 42 Edward III, 1367-8, amounting to £1,203 : 15 : 4, is printed by the KENT ARCH. SOC., *Archeologia Cantiana*, 8vo., London, 1858, ii, 11-131. DEVON, *Brantingham Roll*, 4to., London, 1835, pp. 281, 295, 399, calls him 'overseer or surveyor.'

HERTOGENBOSCH (late Lat. *Boscuducum*, *Silvaduici*; It. *Bolduc*; Fr. *Bois-le-duc*; Ger. *Herzogenbusch*). The capital of the province of North Brabant, in the kingdom of Holland. It is about four miles in circuit, and is defended by a citadel and two forts: the canals, which divide the town into nine portions, are also considered a portion of the defences. The five places are not very striking; the cathedral, dedicated to S. John, is one of the finest churches in the kingdom. It is 320 ft. in length from the end of the lady-chapel to the extreme end of the nave, excluding the old tower; 160 ft. across the inside of the transept, and 124 ft. in width between the aisle walls. It has a nave and choir, both with double aisles, the choir having also a lady-chapel in four bays on the north side, and additional buildings on the south side:

the present or old tower stands in the middle of the west front; the proposed central tower at the transepts has never been finished sufficiently to be vaulted. The foundations of the church were probably laid in 1260, the roof was finished in 1312, and the central tower, of wood above the roofs, was stopped in 1525, when it had attained the height of 300 ft: it had three galleries externally, and is said to have been erected by Johannes Popilius, a townsman: an old chapel on the north-west side, next to the tower, is considered to date from before the thirteenth century; parts of the side aisles are not earlier than the end of the fourteenth; the lady-chapel and sacristy belong entirely to the fifteenth; the south porch was erected in the last quarter of the sixteenth; the cupola on the intersecting transepts belongs to the seventeenth, centuries. In 1410 the edifice was damaged by a storm, in 1419 by fire, in 1566 by the iconoclastic reformers, and 25 July 1584 the central tower was burnt by lightning: in 1589 the repairs had commenced, but were soon stopped, after the vaults of the transepts and the western tower had been rectified: the present deformity called a spire was built in 1843. The records were destroyed in the great fire 1463, according to DE JONGE, *Bijdrage*, fol., Amsterdam, 1847, giving a plan and view, who cites MOBACHIUS, *Beschreibung*, 1789. The *ATHENÆUM Journal*, 1859, p. 588, notices that the repair of this building was entrusted to Durler of Antwerp with Zwirner of Cologne. From 1360 the establishment was collegiate, 1560-1 it became cathedral, and 1629 the chapter was suppressed. The marble screen of the choir deserves notice. Fourteen other churches; the *stadhuis* or town hall, the immense cellar under which was made 1529 by Dierex and Hanenberch, city architects; a synagogue, an academy of arts, an arsenal, four barracks, a military house of correction, two schools, two hospitals, and two almshouses, are the other architectural features of this city.

HERTYNGDON (ADAM DE), an ecclesiastic and a canon of Windsor in 1366 (Rot. Orig. 39 Edward III, ro. 20; and Issue Roll, 40 Edw. III), succeeded William de Mulsho as "clerk of the king's works as well within as without the king's castle of Windsor, and in the king's manor within Windsor-park, and also in the manor and lands of Wythmere, Folie John, Easthamstead, and Cold Kenyngton, and of the palings and other enclosures," etc.; in 1370 he was also one of the chamberlains of the receipt, in which capacity he was sent into the counties of Gloucester, Worcester, and Hereford to borrow money for the king. He held the appointment in 1376, and was succeeded by A. Brocas, who was clerk of the works there and at the Tower of London, Easter term, 4 Richard II, 1381. DEVON, *Brantingham Roll*, 4to., London, 1835, *passim*; and *Issues*, etc., 1837, p. 202; TIGHE and DAVIS, *Annals of Windsor*, 8vo., London, 1858, i, 178-182; TURNER and PARKER, *Dom. Arch.*, 8vo., London, 1853, ii, 28.

HERVEY (FREDERICK AUGUSTUS), fourth earl of Bristol 1779-1803 and bishop of Londonderry, built Down Hill, near Coleraine, which he bequeathed to the rev. Sir Henry Hervey Aston Bruce, bart.; NEALE, *Seats*, 4to., London, 1823, vi, which also notices the mausoleum there, to the memory of the earl George William his brother, who died 1775. Ickworth, Suffolk, was erected for him from the designs of M. ASPRECCI of Rome, carried out by F. Sandys as resident architect 1792-1803, when it remained unfinished for twenty years, the wings being then added, and was first inhabited in 1850; he also erected Ballyscullion house, near Belfast, called the Irish Fonthill: it was pulled down and the portico re-erected 1811-12 at S. George's church, Dublin. These works have been generally attributed to the earl as erected from his own designs. GRUBENMANN.

HESIUS (FR. . . . W. . . .) erected 1650-66 at Louvain the three ailed Italian church of S. Michael, with semicircular apsidal terminations to the choir and transepts; until 1778 it belonged to the Jesuits. WEALE, *Handbook to Belgium*, 8vo., London, 1859, 255.

HESKETH (LLOYD HESKETH BAMFORD), esq., born 9 August 1788, built 1816-24 from his own designs Gwyrrh castle, Denbighshire, near Abergelle, in the style of the castles of Edward I; NEALE, *Seats*, 2nd ser., ii, 4to., Lond., 1825. He died 1862.

HESSEN GLASS, see GLAZIER.

HESSERODE (HEINRICH VON), *baumeister*, began 1374 the tower to the town church at Homberg in Hesse. 116.

HETHE (. . .) is called a master mason, with others, in DALLAWAY, *Discourses*, 8vo., London, 1838, 423; but A. WOOD, *Antiquities of Oxford*, etc., 4to., Oxford, 1786, iii, 256, states that "the work of building All Souls college was carried on under the supervision of J. Druell, assisted from time to time by several others as Hethe, Wrabey, and Balle," from 1437. DRYELL (JOHN).

HETZEL (HEINRICH), *stadtmaler* or city mason of Danzig, completed the vaulting of the *dom* in that city 1498-1502. 92.

HETZENDORF VON HOHENBERG (JOHANN FERDINAND), *baumeister*, was born 1732 at Vienna. He studied architecture at the academy in that city, and travelled in Italy and the principal states of the German empire. In 1763 he built the hof-theatre at Schönbrunn; 1775 the *säulen-gang* or gallery in the imperial gardens; the palace for Count de Fries on the Josephsplatz at Vienna; and also the *lustschloss* or summer residence at Feslau. He painted with great skill decorations for theatres; and published drawings on the principles of distribution of light and shadow. He was imperial court architect, councillor and director of architecture at the academy of Fine Arts at Vienna 1775; and member of the French academy of architects at Rome. He was living in 1807; the date of his death is not recorded. 26. 68. 69. 116.

HEURTIER (JEAN FRANÇOIS), not HEURTIER as sometimes printed, was born 6 March 1739 at Paris. On the recommendation of the marquis de Thiboutot, first lieutenant-general of artillery, he was enrolled in the army as draughtsman of plans and fortifications. After the peace in 1763 he continued his studies, obtained 1764 the *grand prix*, and went to Rome for the usual three years. After his return he settled at Versailles, and was appointed one of the inspectors of the chateau and its dependencies; architecte du roi; and inspector of all the buildings at Versailles, where in 1777 for Louis XVI he built the *salle de spectacle* which holds 200 people. During the revolution he held similar appointments at Versailles; was afterwards appointed inspector-general of the highways of Paris; and a member of the conseil des bâtiments civils. His principal architectural work was 1782 the *salle Favart*, called afterwards the théâtre des Italiens at Paris; it was burnt in 1838; the roof is given in KRAFFT, *Art. de la Carpenle*, fol., Paris, 1803, pt. ii, pl. 55, p. 20. In 1776 he was elected a member of the académie royale d'architecture, and was elected 1801 a member of the académie des beaux arts. He died at Versailles 16 April 1822 aged 83 years. QUATREMÈRE DE QUINCY, *Eloge*, etc., 24 Oct. 1824, in his *Recueil de Notices Hist.*, etc., 8vo., Paris, 1834. Heurtier took Fontaine nominally as a pupil; and obtained for him the grant for a residence at Rome. 110. 113. 114. 116.

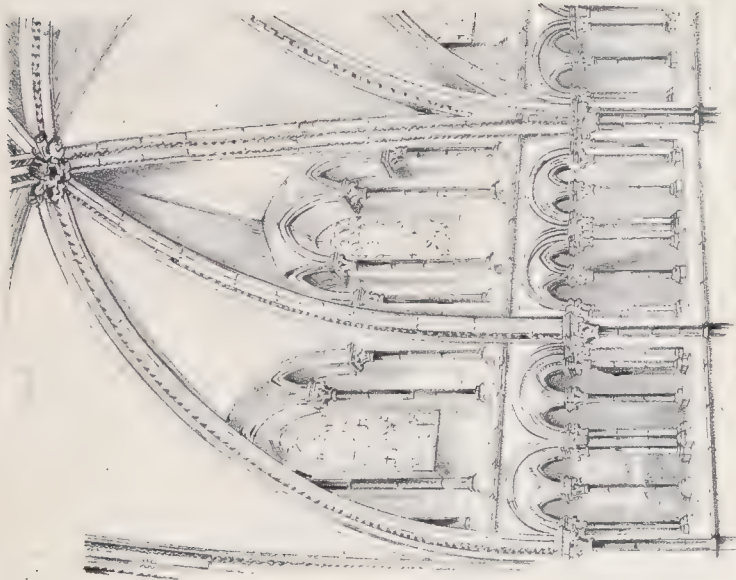
HIEUVEL (HENDRIK VAN DEN) living at Rotterdam about the middle of the seventeenth century; with Kryger enlarged 1639 the Roman Catholic church called Prinskerk in that city: SPAAN, *Hist. of Rotterdam*. 24.

HEVER, see GEVER and GIAFAR.

HEWER (FR. *tailleur de pierre*). The labourer who works stones after they are gotten in the quarry.

HEWET, HEWIT, HEWITT and HEWYT (SIR THOMAS), knight, was 7 January 1715 appointed surveyor-general of his majesty's woods, north and south of the river Trent, in which office he was succeeded 6 July 1716 by Rob. Young, esq. In 1718 he reported on the condition of Cibber's theatre, "it was printed in the newspaper;" CIBBER, *Apology*, 12mo., London, 1756, ii, 48: 4 August 1719, was appointed surveyor of

HEXPARTITE GROIN



upheld by a central pier



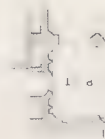
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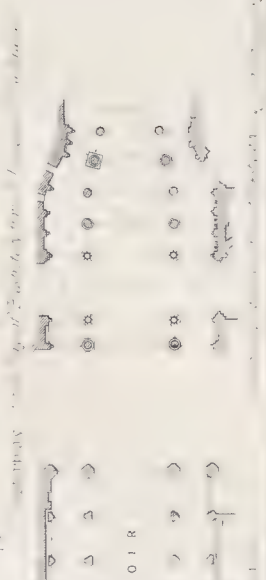
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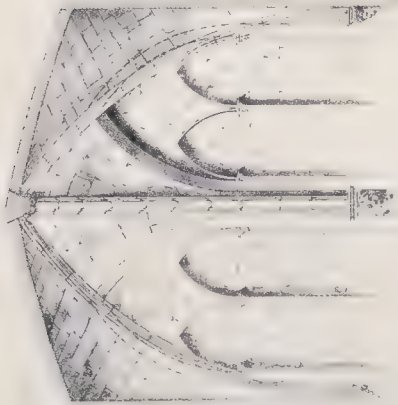
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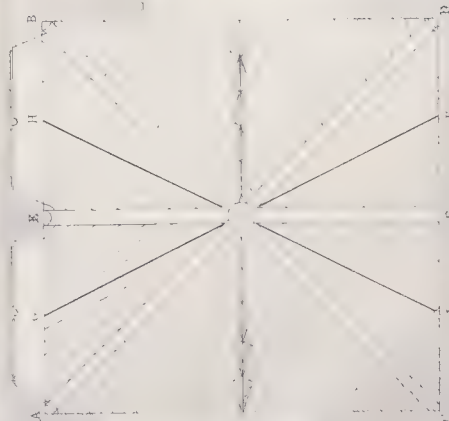
Decorative finial



CHOIR



upheld by a central pier





the king's works in the room of William Benson, removed; and 14 Oct. together with Sir John Vanbrugh, Tobias Jenkins, esq., Nicholas Dubois, and Grinlin Gibbons, gent., was appointed commissioner of his majesty's works; HISTORICAL REGISTER. On 19 March 1721 he laid the first stone for king George I. of the new church of S. Martin's in the Fields. He was knighted 23 Nov. 1719; and died 9 April 1726, being then "of Shire Oaks, Nottinghamshire"; he was succeeded by R. Arundel.

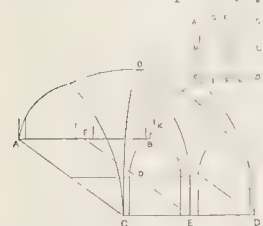
HEWN STONE. The term applied to stone that has been gotten and scaped in the quarries and has been worked upon the building roughly, to suit the precise position in which it is to be placed. The term is used in contradistinction both to the stone that is inserted in the state in which it leaves the quarry, and to the stone that is rubbed, or polished. **BROACHED WORK.** G. R. B.

HEXAGONAL CHURCH. In some cases a hexagon has been adopted for the plan of a church: amongst them may be cited that erected about 1628 by G. Coccapani for the convent of Sta. Teresa de Gesù at Florence; the church commenced after 1706 at Obidos near Lisbon, but not finished although before 1777 nearly £25,000 had been expended upon it: the chapel of S. Mathias, repaired by Lassaulx, in the castle of Cobern near Coblenz; and the chapel of the cemetery at Avioth, given in VIOLETTÉ LE DUC, *Dict.*, s. v. Chapelle, p. 448. This term is not well applied to the chapel at Planès, and to such six-sided chapels as those at Pontigny and at Amiens, shewn by the same author, pp. 443, 465, 474. 28.

HEXALPHA. The name given to the six-pointed star, on which plan the chapel at Planès above mentioned is founded.

HEXASTYLE. The term adopted from VITRUVIUS, iii, 1, for a rank of six columns or pillars facing the spectator.

HEXPARTITE VAULTING. The name given to a peculiar method of groined vaulting of which there are comparatively few examples in England. It was probably invented as an expedient to cover buildings of a large scale where two windows were wanted in the clearstory of every bay. It is so called because, instead of each bay being divided into four divisions or spandrels, by the diagonal ribs, or *ogives*,



A D, B C; it is divided into six by the additional ribs E F. On the plan the strong lines show the ribs, the dotted lines the ridges. This example is from the chapel of S. Blaise in Westminster Abbey. In this species of vaulting, the highest point o is thrown up considerably, forming a

sort of dome, and this is perhaps the reason why GERVASE of Canterbury calls each severy of the choir there "ciborium;" these diagrams should be compared with GROINED VAULTING, figs. 1 and 2, which shew quadripartite groining. The centre rib, E F, forms a stilted arch, and is parallel up to the springing of the smaller arches. The dotted lines thereon also shew that these smaller arches (those against the wall or *formerets*) cut behind the main groin ribs or *ogives*. This causes the spandrels, A O G, G O E, etc., to be concave on the surface, and gives a very peculiar effect to the vaulting. There are no ridge ribs. The filling in to the main spandrels, A O G, B O D, is much like the usual groining, but that to the others runs parallel to the hexapartite ridges, G O, I O, etc. In the former case the ridge is keyed in by stones of a harder character than the filling in, which assume the curious form shewn on the plan given s. v. in the *Illustrations*, 1863-5. A perspective view of the old revestry, commonly called the chapel of S. Blaise, is given by SCOTT, in *Transactions of the Royal Institute of British Architects*, 5 and 19 Dec. 1859. The finest example of this style of groining is at the choir of Canterbury

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cathedral. A very peculiar example of a mixed system at Mouliherne near Saumur, is given by VIOLETTÉ LE DUC, *Dict.*, iv, p. 114. **CIBORIUM; QUADRIPARTITE.** A. A.

HEYDENREICH (ERHARD) was *werkmeister* at the cathedral of Regensburg or Ratisbon, and died in 1524. 92.

HEYDT (JOHANN WOLFFGANG) architect to the prince of Hohenlohe Schillingsfürst, resided in the Dutch-Indian settlements 1735-41, and executed most of the drawings on the spot for the now scarce work, *Allernewester Geographischer und Topographischer Schau-Platz von Afrika und Ost-Indien, — von den wichtigsten der Holländisch-Ost-Indischen Compagnie*, etc., fol., Nur. and Wilhelmsdorff, 1744. 82.

HEYNINX (EGIDIUS STEPHANUS) born 27 Feb. 1813 at Breda in Holland, was educated under F. Duban and in the school of Fine Arts at Paris. He travelled in the south of Europe from 1835 till 1838; and in 1840 became a member of the royal academy at Amsterdam. He constructed the ingenious scaffolding for the repairs of the tower at Breda; and settled at Amsterdam, where he built the second French theatre: a country church was being erected from his designs at the time of his death 26 June 1848. 24.

HEY TOR GRANITE, see GRANITE, p. 71-2.

HEZELON of Liège, see EZELON and CLUNY.

HIBE, in Upper Egypt, see HEB.

HIBISCUS MACROPHYLLUS. A wood of Tavoy in Asia, obtained from a middle-sized tree, and used for common building purposes. *Hibiscus tiliaceus* (*blue mahoe*) of Jamaica is remarkable for its toughness. 71.

HIBON (. . .), was practising in the beginning of this century at Paris and up to 1831, but his death is not recorded. DETOURNELLE, *Recueil*, etc., 4to., Paris, an. xiii (1805), gives, pl. 17, a design by Hibon made in competition for a monument to general Desaix; pl. 51, a triumphal arch for the *grand prix* in 1801; and pl. 98-9 the colonne départementale for Bruxelles, being one of the selected designs; Hibon also engraved several of the plates for this work. ALLAIS, and others, *Projets, etc.; Grands Prix*, fol., Paris, 1806, give pl. 79-80, the column designed to the honour of the army of reserve, at Dijon, which gained the "medal of emulation" 20 Dec. 1800. GABET calls him "architecte-graveur au trait," and gives the following engravings as executed for the *exposition au salon* of 1817; interior view of the halle aux vins; with views of the fountains des Innocents, and du Châtelet: there are also by him a view of the salles du musée, for CLARAC, *Musée de Sculpture*, etc., 4to., Paris, 1826-53; some fine plates for HITTORFF and LECOINTE, *Baptême du Duc de Bordeaux*, etc., fol., Paris, 1827; and those for PERCIER and FONTAINE, *Plans de châteaux, palais, etc., de France, d'Italie, d'Espagne et de Russie, dessinés sur une même échelle*, fol., Paris, 1833. 68. 69. 110.

HICK. A very hard, fine, close, very uniformly grained, and heavy wood of Ceylon, in colour resembling pencil cedar. 71.

HICKORY, see CARYA and JUGLANS.

HICK JOINT POINTING. A term given to that species of pointing in which, after the beds and joints are raked out, a portion of superior mortar is inserted and made perfectly smooth with the surface. It differs from flat joint or common pointing, which is only smoothing the mortar between the beds and joints of brickwork as the courses are formed. 1. 2.

It is a quick and ready method of forming a ground for laying tuck pointing upon, with a grooved pointing iron when the mortar is stiff; or with a small brush when white lead or liquid mortar is used to indicate the jointing. This work is merely veneering in mortar; it is by no means durable, and therefore is not suited for situations much exposed to the weather. It is also employed for red brickwork just before striking the scaffolding, the whole face being washed over with a liquid to stain the work one colour. **HIGH JOINT.** R. R. R.

HIDALGO (JUAN FRANCISCO), succeeded Gaspar de la Peña in the office of *maestro mayor* at the cathedral church of Cor-

dova in Spain, where he began 1664 the sixth story of the tower at the entrance to the *patio* or court; and introduced a series of arches in the cathedral for the purpose of uniting it with the chapel of S. Clemente. He continued to work until 1684, but the date of his death is not recorded. 66.

HIDE (Ang.-Sax. *hyd*; Med. Lat. *hida*, *hyda*). A measure of land among the Anglo-Saxons, continually referred to in Domesday Book, and by subsequent writers. DU CANGE, *s.v.*, cites Henry of Huntingdon, Brompton, Ralph de Diceto, and Matthew Paris, to show that the hide of land was as much in quantity as could be conveniently cultivated by one plough. Of course when the vast difference in quality of the lands in England is considered, it will not be wondered that the difference of statement as to the number of acres in the hide should be very great. If the light lands of Norfolk are contrasted with the chalk of Wiltshire; and these again with the heavy clays of Essex and parts of Kent; and if the difference between a small curtille plough with a pair of horses, and the heavy wheel plough of the strong soils, dragged with difficulty by six powerful cattle, be considered, the variation in quantity among the writers will not be a matter of surprise. DUGDALE, *Warwick*, fol., Lond., 1656, p. 65, says "four yard lands make one hide." DU CANGE quotes Ordericus Vitalis and Roger Hovenden, to prove that the Norman carucate was the same thing as the Saxon hide. A writer in the *ARCHÆOLOGIA*, xxxiii, 272 (xxxv, 470), shows that in the reign of Edward III the carucate was 112 acres. But the Domesday Book (KELHAM, 8vo., London, 1788, p. 231) shows there are six carucates in every hide of land; and that the hide was 100 acres, *i.e.* 120 acres English measure. In the next page, he shows from the same MS. that a hide contains only 64 acres; and that the hide belonging to a Richard was worth 20 shillings, and that of a Herfrid only 10 shillings, or half the money.

The hide, however, was never intended to be a superficial measure of land at all. It was the estimate of the landowner's ability to pay the tax called *geldum*. This, or as it is generally designated, 'Dane geld', was a sort of land tax first imposed in the reign of Ethelred as a fund from whence to provide ships and other defences against the incursions of the Danes, and the method adopted of ascertaining the respective ability of the taxable or 'geldable' lands, was simply to inquire what number of plough-teams each tenant was able to keep. The hide is generally considered to be subdivisible into four *virgates*. KELHAM states that the virgate differed from 15 to 40 acres; and as a proof that the light lands included the largest number, he shows from BLOMEFIELD, *Norfolk*, that the virgate was 40 acres, or 4 *fardels*. This would make the East Anglian hide as much as 160 acres, and still further elucidate the reasons for the discrepancies in the quoted measurements. A. A.

HIDING PLACE. A hollow place formed in a building to secure goods or persons. These were very usual in mediæval and in later buildings, but they are not known in ancient works. At Oxburgh hall, Norfolk, under one of the floors of the gatchouse, is a space about 6 ft. long, 5 ft. wide, and 7 ft. high, access to which is only obtained by a trapdoor of wood, so covered with bricks as apparently to form part of the pavement; the door turns on an iron axle in its centre; BRITTON, *Arch. Antiq.*, 4to. London, 1807, ii, 88.

HIENIPA. The ancient name of ALCALA DE GUADAIIRA or DE LOS PANEDEROS, in Andalusia.

HIERAPOLIS. The ancient name of a town, now represented by the village of Pambou Kale, also called Tabuk Kale, about five miles north of Laodiceia in Asia Minor. The water running from the calcareous hot springs has deposited lime so rapidly that the place exhibits stone cascades and stalagmites, which deserve the admiration expressed by TEXTIER, *Asie Mineure*, fol., Paris, 1839-49, i, 137-143; a fragment was presented by E. Falkener to the Royal Institute of British Architects; and the manner in which the ditches between properties were gradually raised into fence walls is noticed by

ARUNDEL, *Visit to the Seven Churches*, 8vo., London, 1828, pp. 79-84. Sepulchres, in the shape of single chambers (lighted by small windows closed with stone bars or pales), having fronts decorated with the Doric order, or in the form of sarcophagi (some of which retain their covers), extend for half a mile along the western road to the town. The portico of square piers with half columns, extending about 150 paces as mentioned by ARUNDEL, does not appear to be noticed by TEXTIER; both authors, however, name the entrance with three arches between two round towers, which TEXTIER considers to have belonged to the market-place. Although the last named author mentions that the lime has accumulated over the site to a height of six or seven feet, the main street is noticed by LEAKE, *Tour in Asia Minor*, 8vo., London, 1824, pp. 251-4, 326-8, as still traceable for its whole length, and bordered by the remains of three Christian churches. One of these, about 300 ft. in length, occurs at a distance of 100 paces from the archway; and about the middle of the street, just above the mineral source, POCOCKE, *Description of the East*, fol., London, 1745, 2, ii, 12, thought that he saw traces of the temple to Apollo. Between the source and the theatre, COCKERELL discovered the Plutonium or mephitic cavern, which seems to have been since lost. His plans of the theatre and gymnasium are given in LEAKE, p. 341; and views of the gymnasium (called *therme* in the text), with the theatre, and of the church, are given in TEXTIER, pl. 53, 54. The theatre, showing perfectly the seats, the thirteen vaulted entrances, and great part of the proscenium, is apparently as much worth study as that at Aizani: it is noted by LEAKE, p. 326-8, from Cockerell's measurements as being 100 ft. in diameter and 346 ft. in total width, and as having in the centre of the scene a great niche like that at Laodiceia, at Nicopolis of Epirus, and at some other theatres of Roman construction. The excuse made by TEXTIER for the neglect of this example, is an allegation that soft water does not occur nearer than twelve furlongs: but ARUNDEL mentions tolerably pure water as obtainable on the spot. LEAKE notices the gymnasium as one of the only three gymnasia or palestæ which are in a state of preservation sufficient to give any useful information on the subject of those buildings; the two others (GYMNASIUM), viz., at Alexandria Troas, and at Ephesus, are given by the SOCIETY OF DILETTANTI, *Antiquities of Ionia*, fol., London, 1797, ii, pl. 40 and 54. But this building was the *thermæ*, according to TEXTIER, who mentions that the great hall leads to a court having at each end a hemicycle that is separated from the principal area by a range of six square piers with Corinthian capitals, this is noticed as a peculiarity in antique art; ATTIC ORDER; and some of the shafts appear to have bent. ARUNDEL, 82, quotes the words of an author, that the huge vaults of the roof—"being stones of an incredible magnitude and weight—are there close cemented,—without the help of timber,—or of arched work, and are joined so artificially, that unto this day they remain immovable." The site of a stadium appears to have been observed only by CHANDLER, *Travels in Asia Minor*, 4to., Lond., 1775, p. 233.

HIERAPOLIS. The Greek name of the city which was the Magog and the Bambyce of the Syrians, and is now represented by Kara Bambuche or Buguk Munbedj, the sacred city of Cyrrhestica in Syria. Some ruined mosques and square towers mark the capital of the Mahometan princes who ruled about 1020-1122, while its ancient state is represented by four large cisterns; a fine sarcophagus; and, amongst other remains, the scattered ruins of an acropolis and of two temples. Of the smaller temple, the enclosure and portions of seven columns exist; but it seems to possess little interest compared with the larger, which is evidently the rich, temple dedicated to Astarte, Astroarche, Atargatis, or Venus Decerto, and plundered by Crassus (B.C. 54); amongst its remains are some fragments of massive architecture, not unlike the Egyptian; and eleven arches forming one side of a square paved court, over which are scattered the shafts of columns, and capitals displaying the

lotus. Pococke, *Desc. of the East*, fol., Lond., 1743-5, i, 166; Chesney, *Expedition*, 4to., London, 1850, i, 420-1. 23.

HIERAPYTNA, in Crete, see ECHERIUM.

HIERONYMITE (It. *girolamino* or *girolamito*, Sp. *geronimo*; Fr. *hérónymite* and popularly *jéronimite*). A member of the society established about the end of the fourteenth century in honour of S. Jerome by some brethren of the third branch of the Franciscan order, and subjected 1372-3 by papal authority to the rules of the Augustinian order. The society, of which three or four forms exist in Italy, flourished chiefly in Spain and Portugal: its most important buildings being those at Lupiana (the centre of authority), Guadalupe, Escorial, and S. Giuste or Yuste, the retreat of Charles V. 40.

HIERUM (Gr. *ἱερόν*, Attic; *ἱρόν*, Ionic; according to HESYCHIUS "a good place, a holy place, a temple"). This word has erroneously been supposed by some to signify the enclosure or *τέμενος* of a temple, and by others to be the same thing as *ναός* or temple; but it is clear they have different meanings, as will be shewn from several authorities. PAUSANIAS, v, 6, states that Xenophon, son of Gryllus, made a *temenos*, a *hierum*, and a *naos*, to Diana. ATHENÆUS, xiii, 595, speaks of the *hierum*, the *temenos*, the *naos*, and the altar of Venus. HERODOTUS, ii, 91, in giving the account of the temple of Perseus, mentions the enclosure of the *naos*, and afterwards says the spirit of the hero was seen in the *hierum*. THUCYDIDES, i, 134; iv, 90; v, 18 and 50, should be also consulted. That the *hierum* was a building or part of a building, and not a mere enclosure, is clear from HERODOTUS, vi, 19, for he mentions the riches in the *ἱρόν* at Didyme, which was plundered and burnt by the Persians. From HESYCHIUS, it would seem that *τεπεῖον* in its primitive meaning is a sacrifice, and *τεπεῖς* the sacrificing priest; if so, it is probable that the *hierum* signified the interior of a temple where the sacrifices were offered, and that *ναός* signified the adytum or shrine. Late writers, particularly travellers, have caused great confusion by affixing the term arbitrarily to any part of a sacred place which seemed to want a name. A. A.

Most of the public sacrifices of the ancients took place in front of the *naos* or *ædes*, where there was, on some occasions, a fixed altar protected by a covering; an example of this is to be found in the temple to Minerva at Priene; and among the ruins of Claros (near a Turkish village called Zille) in Asia Minor; in front of the temple to Juno at Agrigentum, also, are observable seats; according to DONALDSON, in STUART and REVERT, *Antiq.*, Supplement, fol., London, 1830, p. 1. But it should be noticed from his illustrations of the latter example that these seats are rather platforms in the *temenos*; and the *hierum* would consequently be the smaller platform between the three steps of the temple and the five leading up to it from the *temenos*.

This term has been during late years employed with a double meaning: viz., in a restricted sense for a small plot of consecrated ground, such as that in the middle of the necropolis at Cnidus; in a wider sense, for a large area enclosing buildings and a sacred grove. The example at Cnidus, as given by TEXIER, *Desc. de l'Asie Mineure*, fol., Paris, 1849, pl. 162 (who represents it as a piece of ground 138 ft. 9 ins. long and 81 ft. 4 ins. wide, enclosed partly by a wall of Pelasgic construction, and containing two plinths each 19 ft. 8 ins. square and 5 ft. high, upon which had stood a tripod supported upon a stone triangular pedestal about 23 ft. high), is regarded by him as unique; yet it is very much resembled by the exhedra and altar given in the following plate by the same author.

In its wider sense the word is applied to the enclosed precinct, which might have a second name, as the *alos* (Gr. *ἄλος*) of Æsculapius, about five miles from Epidaurus; or the *altis* (Gr. *ἄλτις*, Elean dialect for *ἄλος*) of Zeus at Olympia, both names meaning the sacred grove within the sanctuary. Of this nature were the *hierum* of Poseidon near Schœnus on the isthmus of Corinth; and of Demeter at Eleusis; and possibly the sanctuary of the Muses on Mount Helicon, of the Graces at Orchomenus, and the celebrated *hierum* of Trophonius, as

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noted in the *Handbook to Greece*, were of this sort. The most perfect is that of Æsculapius, which is still called Hieron; to its description, s. v. EPIDAUROS, may be added that this sanctuary also contained other buildings, viz. dormitories for those who came to consult the god; temples to Aphrodite, Artemis, and Themis; a roofed fountain; and two temples built before A.D. 138 by Antoninus Pius in honour of Hygieia and of the Epidotes. Outside the enclosure were hospitals, so that no one might enter or quit the world upon the sacred ground.

HIGGINS (JAMES WHITE) was articled to — Bush, and bought off a portion of the term of his apprenticeship to become fully employed as a surveyor in measuring the extensive Government works then being erected by Messrs. Holland, Copland and Rowles, and others. Before he was twenty-two years of age he had commenced building on part of the ground in Sloane-street, Chelsea, the speculation of H. Holland. In later life he was chiefly engaged in arranging the purchase of property required for opening new streets in the metropolis; in valuing property for railway and dock companies, the city, the office of Woods and Forests, the duchy of Cornwall, and the Boards of Ordnance and the Admiralty. He held, at a salary of £1,000 per annum, the first appointment of one of the official referees under the Building Act 1844, from which he retired after holding that office for a twelvemonth. He was very extensively employed as an arbitrator and referee, the duties of which positions he was considered to exercise with great ability and impartiality; any architectural works he generally handed over to others. He died 13 May 1854, aged 71 years, being then "of Hornead, Herts." *BUILDER Journal*, xii, 293.

HIGGINS'S CEMENT. A water cement or stucco patented 8 Jan. 1779 by Bryan Higgins, M.D. Its manufacture and use are elaborately detailed in his work, *Experiments, etc., of Calcareous Cements, and of preparing Quick Lime*, etc., 8vo., London, 1780, as being thus made: take 56 lbs. of coarse sand, 42 lbs. of fine sand, mix them together, and wet them with a cementing liquor (lime water), add 14 lbs. of purified lime in successive portions and to be well beaten up; then add 14 lbs. of bone ash, mixing and beating all together: the quicker and the more perfectly these materials are mixed and beaten together, and the sooner the cement thus formed is used, the better it will be. This preparation is applied in building, pointing, plastering, stuccoing, and other work, as mortar and stucco. He gives other proportions for cements, of a finer texture; of a much cheaper and coarser grain; as a wash; and of substances that might be used if the purer ones cannot be obtained. As DONALDSON, in *Encyc. Metrop.*, s. v. Stucco, p. 176, states, "it appears not to have succeeded," probably from the great trouble required in preparing the several materials. HIGGINS states that the cement was adopted by Messrs. James and Samuel Wyatt in 1778-9, and used by them on the north front of Mr. Delme's house, south side of Grosvenor-square; north and south fronts of Mr. Viner's house, Conduit-street, Hanover-square (now the premises of the Architectural Union Company), the fore front representing Bath stone; Mr. Bond Hopkins's house at Wimbledon; Mr. Birch's house at Hamstead near Birmingham; and the house of the hon. Justice Willes at Little Grove, East Barnet; with perhaps many others in later years.

HIGH ALTAR (Lat. *altare majus*; Fr. *maître autel*). The principal altar in Roman Catholic churches. It was sometimes called 'God's altar'; and at S. Alban's, where it stood outside the rood screen at the east end of the nave, 'the people's altar.' Its usual place is at the east end of the chancel. In S. Peter's at Rome it stands under the dome. In this and all other basilican churches the high altar is not placed against a wall, but stands detached, and the priest says mass behind it, but facing the people. In the original cathedral at Canterbury; in the old monastery at S. Gall; at Mayence; and several other places there are altars at the west end as well as at the east. The high altar has frequently a canopy or

ciborium over it, and it is sometimes screened by curtains or paraments. BALDAQUIN; TABERNACLE. A. A.

HIGH CHANCEL. When the high altar stands in the chancel or choir, and this has aisles, the centre is often called the high chancel, to distinguish it from the low chancels or side aisles, as well as from the presbytery and lady-chapel. A. A.

HIGH JOINT or FLUSH JOINT. A method of finishing mortar joints in brickwork. When the brick is laid, the trowel is drawn along the top and bottom of the joint, as in n, and the middle is left rough till the mortar is partially set, when the middle of the joint is drawn or struck with a tool called a jointer: the joint then presents the appearance as in z, in BRICKWORK (BEDS AND JOINTS OF). This method is called a 'high joint' because the mortar is flush with the face of the brick; while in the ordinary method, the joint being drawn with the point of the trowel, it is slightly recessed, as at c. A. A.

HIGH MOOR STONE. The rough rock, generally known as Summit, and High Moor, stone (the upper millstone of the geological survey), obtained near Manchester, is much used there in building. It is composed of coarse grains and rounded pebbles of translucent quartz cemented together with partly decomposed felspar and a little iron and manganese in the state of oxide. It is soft when first quarried, and then works pretty freely, but hardens on exposure to the air. As a building stone it is preferred because it works much easier than the two millstones. Parbold, Horwich, Holcome-hill, Blackstone-edge, and Werneth Low, are good examples of the stone. The upper millstone of Holcome, Bank-lanc, Todmorden, Saddleworth, and Tintwistle is a hard and durable sandstone, composed chiefly of silica. This is not in great use, owing to its being difficult to work, but it stands the weather better than the rough rock. The lower millstone, as seen at Roccross and Rhodes-well, Tintwistle, and the lower part of Pendle-hill, contains some excellent building stones, but they are hard to work and therefore not much used; but they are, no doubt, some of the strongest and most durable stones of the series. In the lower parts of it are some beds of fine-grained sandstone, more free to work than the upper beds; a most excellent bed of this description is found at Bailey, near Ribchester. BINNEY, *Remarks on the Building Stones used in Manchester*, given in *Builder Journal*, xviii, 27.

HIGH PRESSURE STEAM. A term employed to designate steam that was originally used at a pressure corresponding with an effort of more than about 20 lbs. per in. superficial above that of the atmosphere, which is 14 lbs. per in. Formerly, this pressure of steam was considered necessary to overcome the resistance of the atmosphere on the other side of the piston, which only worked through the excess of pressure thus brought upon it; but, at the present day, condensing engines are made to work with steam of 40 lbs. pressure, so that the term has now become very vague and indefinite. In a heating apparatus, etc., the pressure is very often as high as 200 lbs. per in., or even much higher. High pressure is also a term applied to water used as a motive power when it exceeds the power which would correspond with that of a head of water of about 40 ft. vertical pressure upon the pipe conveying it; this is by no means an unusual pressure for hydraulic cranes, and is about analogous to that above quoted for steam. The joints of pipes must be made with reference to the pressure they will have to support. IGNITION. G. R. B.

HIGH TOMB. An old term for an ALTAR TOMB.

HILAIRE, see HYLAIRE (G. DE SAINT).

HILD (JOHANN BAPTISTE, or JOSEPH according to some of the authorities quoted below) was a member of the imperial academy at Vienna. He studied at Rome, and constructed between 1832-37 the cathedral at Erlau in Hungary, in the Greco-Roman style. A notice highly commending this work is given in the ALLGEMEINE ZEITUNG for 1837 (Ausserordentliche Beilage, p. 957). But neither his other works nor his death are recorded. ERLAU. 26. 68. 69. 116.

HILDEBERT, abbot of L'Île-Barbe, built in 985 a church and a new convent; RAMÉZ, *Manuel de l'Hist. Arch.*, 12mo., Paris, 1843, ii, 133.

HILDEBRAND (. . .) about 1750 constructed many buildings at Potsdam, and was 1754 appointed royal land baudirector. He left the service about 1766, and it is not known when and where he died. 68. 69. 116.

HILDEBRAND (JOHANN LUCAS) was born 1660 at Genoa according to NAGLER, but 1666 according to MULLER. He went with general Preiner to Vienna and entered the service of the emperor Charles VI, by whom he was raised to the rank of nobility. He constructed in that city the palace for prince Eugene of Savoy; and also that for prince Wenzeslaus Kaunitz. According to a notice by G. A. HERZUS, Hildebrand also constructed the triumphal arch in front of the great entrance to the imperial burg; a description of which is given in HORMAYR, *Geschichte Wiens*, etc., 8vo., Wien, 1823-4, ii, pt. 2, p. 16. He died, according to MULLER and FÜSSL, in 1730; and according to NAGLER, in 1750. HILDEBRAND. 69. 116.

HILDENLY QUARRY, in Yorkshire, may have furnished the stone for Kirkham priory in the thirteenth century, it being very similar to the limestone used in the body of the church, which remains very perfect, though many of the stones are much decomposed; *Report on Building Stones*, etc., 1837.

HILDESHEIM (Lat. *Hildenshemium* and *Hildesia*) was, until the fall of the German empire, the residence of the prince bishops of the diocese of Hildesheim; and it is now the capital of the province of the same name in Hannover. It is the seat of a bishopric founded 798 at Königsaal, removed 814 to this place, on the Innerste, over which are four bridges. The town is divided into the Old and New towns, containing about 2,000 houses. The Old town (*Altstadt*) which forms two-thirds of the whole area, contains about forty crooked and narrow streets paved with stone. Most of the houses are two storied timber constructions covered with red tiles; and except on the great *dom-hof* there are but few large buildings. The station of the railway to Hannover is given in the ALLGEMEINE BAUZEITUNG, 1851, pl. 405. In the *Alt-stadt* are: the *marktplatz*, with the great and the small *dom-hofs*. The great *dom-hof* has on the south side the *dom-kirche*, and on the north, east and west, sides public buildings, the latest of which were designed by the *baumeister* Giuseppe Cortogino, such as the *landrostei* (governor's house), the post office, and the *landschaftshaus* (provincial states). A row of linden trees encloses the square, in the middle of which was placed 1810 a stone pedestal 4 ft. in height, having on it a monument of brass 14 ft. 6 ins. high, and 6 ft. 4 ins. diameter, dating 993-1022, made for bishop S. Bernward; twenty-eight bas-relief groups elaborately worked wind upwards eight times in spiral bands, and refer to the life of Christ; it formerly stood in the church of the abbey of S. Michael. It was partly destroyed in the sixteenth century, and in 1650 was deprived of its artistically constructed capital, surmounted by a crucifix. Separated from the great *dom-hof* by a three-arched gallery communicating with the *schloss* (bishop's palace), which served in former times as a covered passage for the official procession of the prince-bishops or their lieutenants—is the small *dom-hof*, with its park-like grounds and plantations; having on its east side the episcopal college and the gymnasium Josephinum. The market place is surrounded by numerous stalls and shops;—on the eastern side is the *rathhaus* or town hall, built in the old German style, the oldest part dating in the first half of the fifteenth century. In front of it, and in the middle of an octagonal sculptured basin, is a fountain, erected 1540. Among the other edifices are the Roland's Institute (*stiftshaus*) for ladies, a convent founded 1769 by J. E. Roland, town councillor; and the so-called *Tempelherrenhaus*, of the second half of the fifteenth century, now converted into a winery. The only private building deserving notice is a house in the Langenhagen; its façade having four full sized statues, with many

medallions, etc., bears the date 1586-7, and is unmistakably by an Italian master.

Before the Reformation 1542 Hildesheim contained besides the *dom-stift* (cathedral chapter), one of the richest in Germany, and four collegiate chapels, several churches, and monastic establishments, many of which have been abolished or converted to other purposes since that period. Six churches were adapted for the Reformers, the others remain to the Catholics: only three now belong to the former, the other three having been secularised after 1810. S. Michaelis-kirche, built 1001-22 by bishop S. Bernwald, is a good specimen of the Romanesque period, being a nearly unaltered basilica, having two apsidal choirs, transepts, two crypts, and two towers; it was converted after 1827 into a lunatic asylum; the crypt contains the tomb of S. Bernwald, and there are two chandeliers of his epoch which are said to be cast in a peculiar metal: S. Pauli-kirche has been transformed into a warehouse: S. Andreas-kirche, the principal Protestant church, is a three-ailed edifice, the oldest part dating 1022-38; the nave after 1200; and the choir 1389; it has an unfinished tower. Close to it is the gymnasium Andreanum, founded 1664 by Peter Timpe, a merchant. S. Jacobi-kirche, a chapel until the Reformation belonging to S. Andreas, was built 1504, and its pointed pyramidal-shaped tower, the highest in the town, was finished 1514: S. Martin-kirche, the Lutheran church, formerly a Franciscan convent, was 1547 appointed to be the metropolitan church; and its monastery, built 1242, was 1691 converted into an orphan asylum. The dom-kirche, dedicated to the Virgin and SS. Peter and Paul, founded 818, is a cruciform building (KING says of the tenth century) with its cloisters at the east end, and completed about 1061 by bishop Hezilo. The side chapels in the aisles date in the fourteenth century. It has two towers, the greater one over the west façade was 1840 in course of re-erection; it contains a *sonnerie* or peal of four bells weighing 300 cwt., considered the most melodious in Europe. The other tower, erected by bishop Gehrard, in memory of the victory gained by him 3 Sept. 1367 over duke Magnus of Brunswick, surnamed Torquatus, rises in the middle of the cruciform copper roof and has a gilded cupola. The interior of the building, is said to be 209 (German?) ft. in length and 103 ft. in width; the plan given in KING measures 199 ft. and 91 Eng. ft. respectively. The crypt contains a silver altar; over the crypt is an elevated choir contiguous to the *schatzkammer* (treasury), in which are kept silver reliquaries of the eighth century; and a golden chalice dating 1146 is considered one of the most beautiful in Germany on account of its chasing. This edifice also contains the so-called *Irmensäule*, a monument of mottled marble 11 ft. in height with gilded bronze rings, and an inscription, given in GRIMM, *Irmenstrasse und Irmensäule*, Wien, 1815; MEYER, *Grosse Convers. Lexikon*. 8vo., Hildburghausen, 1850, xvi, 870; one author calls it a "hollow cylindrical pillar of coloured alabaster 16 ft. high, now surmounted by a cross, but supposed to have originally supported an idol, and later an image of the Virgin"; and another, "a pillar of greenish marble". Two brass gates about 17 ft. high, 4 ft. wide, and 1½ in. thick, adorned with eight or twelve bas-reliefs to each valve, were given 1015 by S. Bernwald (poor); the bronze font with a cover, the finest of the kind in the world, is carefully described by KING; it dates in the latter half of the thirteenth century, and was given by a priest named Wilbernus (it was removed from the west end to the chapel of S. George in 1653); the brass effigy; the altar cross; the missal binding; the pastoral cross and the staff; the sacristy doors of open metal work; and the corona 67 ft. in circumference supporting 72 prickets and sconces or lanterns, arc, with the building, given by KING, *Study Book of Mediæval Architecture*, 4to., London, 1858, ii, 19 plates, and a chalice and paten from S. Maurice-kirche. The gilt shrine of S. Godehard, 4 ft. long, dates probably 1131; and the rood loft 1546 is

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noticed for fine Renaissance tracery and carving. The Kreuz-kirche, founded 1079, formerly a collegiate chapel of fifteen canons, was in 1810 converted into a Catholic church; the altar cross is given in KING. Close to it is a three-storied hospital for females erected 1840; and on the Brühle is the Episcopal seminary 1834, formerly a Capuchin convent and originally the *fraterherrn-haus*, with a church erected 1772. Beyond the Brühle is an edifice with three pyramidal-shaped towers, built 1133-80, which belonged to the Benedictine convent of S. Godehard. It is cruciform with nave and aisles, and is said to have been erected after the model of the dom built by the emperor Lothar II (1125-38) at Königsutter (others say of the dom in the city), and is a fine Romanesque structure; after having been shut up, it was in 1816 restored to the Catholics. A chalice, and a ciborium of cocoa-wood, in this church are given in KING. Near the dom-kirche stands the *schloss*, or prince bishop's palace; the upper floors of which are now used as courts of justice and of the consistorium. It has been many times restored, but presents nothing very remarkable in its architecture. The site of the ancient *schloss-capelle* is now occupied by a private house.

The *Neu-stadt* was formerly separated from the *Alt-stadt* by walls, ditches and ramparts, which were levelled and converted into promenades after 1582; but the seven gates in the latter part still remain; and it contains about a dozen streets with plain timber houses. S. Lambert church belonging to the Lutherans, 1489 in a Gothic style, is a three-ailed edifice, given in KING, pl. 12; in front of it is a spacious market-place, in the middle of which is a fountain; and except the *gross-vogtei* (residence of the provost, and formerly that of the *dompropst* or dean); and a few other buildings, there is little to be noticed. Besides the two Lutheran and Catholic gymnasiums, there are the Episcopal college; a *real* school; two higher schools for girls; an asylum for the deaf and dumb; a public and two gymnasial libraries; fifteen hospitals; two orphan and two lunatic asylums; a synagogue; an arsenal and barracks.

In the environs are the schloss of count Dorneburg, formerly a Cistercian abbey, with a fine collection of antiquities: the residence of count Stolberg at Söden with its picture gallery: and the still well preserved ruins of the old castle of the *raugraf* of Woldenburg. LANGE, *Original Ansichten von Deutschland*, 4to., Darmstadt, 1842-3, iv, gives engravings of the dom-kirche; of the market place; and a general view of the city. 14. 28. 50.

HILDUARD, a Benedictine monk, was employed about 1170 by abbot Foucher to rebuild the church of S. Pierre at Chartres; WHITTINGTON, *Hist. Survey*, 8vo. London, 1811, p. 59; but BULTEAU, *Descr. de la Cath. de Chartres*, 8vo., Chartres, 1850, p. 280, says he directed the works of the choir 1150-65, or later.

HILING, see HEALING and HILLIER.

HILL (ROBERT DE) "controller of the works of the new chapel of S. Stephen within the palace" of Westminster, extending from the fourth to the seventh year of Edward III (1330 to 1333), when he was succeeded by John de Broghton. BRAYLEY and BRITTON, *Palace of Westminster*, 8vo., London, 1836, p. 148.

HILLAH, see BABYLON.

HILLEBORCH (THOMAS) *baumeister*, finished in 1498 the *rathhaus* at Wernigerode in Prussia. 92.

HILLEBRAND (. . . von) *baumeister* at Vienna about 1745, was perhaps a son of J. L. HILDEBRAND, whose name FUSSLT supposes is mis-spelt. 69.

HILLIER or HELLIER. A term used in the western parts of England for a slater or tiler. HEALING; HELE.

HILTS, HILTZ, HILTZEN, and HÜLTZ (HANS) the elder, *baumeister* of Cologne, went about 1339 to Strassburg, and conducted, after the deaths of Erwin von Steinbach (1318), and his son Hans (1339) that part of the tower of the munster called the four winding staircases (*schnecken stiegen*), until

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1365, up to the beginning of the cupola. It was continued by others and then by HECKLER. MERLO, *Nachrichten von dem Leben und den Werken Kölnischer Künstler*. 116.

HILTS, HILTZ or HÜLTZ (HANS) the younger, also *baumeister* at Cologne, is noticed 1421 for the first time, as employed at the münster at Strassburg, where he finished the staircases in 1435 and the whole tower 1439. He died 1419 at Strassburg. *Deutsches Kunstblatt*, 1855, p. 317; GRANDIDIER, *Essais etc. église de Strasbourg*, 8vo., Strasb., 1782, p. 49, gives his epitaph.

HIMSEL or HIMBSEL (JOHANN ULRICH) *baumeister* and engineer, was born at Neunkirchen in the then circle of Regen, Upper Pfalz, in Bavaria. He studied and practised at first under his father, who was a *land-baumeister*; then at the Munich academy under professor Fischer, with whom he went to Paris, where, with the assistance of king Maximilian he attended the courses at the academy of arts. In 1810 he was appointed royal *bau-inspector*, and was allowed the following year to travel through Italy at the government expense. On his return he designed many private as well as public buildings; among the latter, the school-house at Munich. In 1816 he was created *baurath*, and as such was employed by government. He published *Magazin der Baukunst*, in five parts. In 1824 he conducted the public festivities for the celebration of the king's jubilee; these were published with many plates of decorations and sceneries. In 1825 he was commissioned by government to visit France and Italy. As an engineer he constructed the railway between Munich and Augsburg, overcoming with skill the many obstacles which presented themselves. MÜLLER, *Handbuch von München*. No record of his death has been found. 68. 116.

HINDOO ARCHITECTURE. After the example of FERGUSON, *Illustrated Handbook*, 8vo., London, 1855, p. 85, this article will not include the succession of styles that have occurred in Hindostan, but will be confined to the works produced by the followers of the Brahmins who respectively adore Vishnu and Siva; and the same author, p. 130, will be followed in considering as probably Jainite, and therefore in excluding that curious mixture of the trefoiled arch with pseudo-classic work which result in a form of design easily recognised as peculiar to Cashmere. He states, p. 65, that the Hindoos did not introduce anything like a new style of architecture, but that they adapted the Buddhist style to their own purposes; in p. 85, however, he divides the architecture of the Hindoos into three perfectly distinct, though contemporary, styles, viz., the Cashmerian, the Arian or northern, and the Tamul or southern.

He considers that the northern Hindoos had a different style from the southern, and adopted other forms; though he allows that it is difficult, as the style was perfectly mature in the seventh century, to guess what the original type may have been from which its peculiar features were derived. At p. 117, however, he speaks of "pure Hindoo, or rather Jainite forms of columnar architecture", apparently having affinity to no types that are familiar to him, and therefore seeming to have been invented on the spot. He adds that the changes which the style underwent were slight until after the reign of Akbar (1556-1605), when the introduction of Saracenic forms gave it a freedom and a grace before unknown; that, though its details became less pure, its forms were improved by those additions; but that it is now sinking under the English influence until it is little better than a caricature of its former self. From A.D. 657 to the present day the series of its buildings is tolerably complete, and shews a progress of style that was slow, but sufficient to enable a practised eye to detect at least the century to which a building belongs. The chief peculiarity is to be seen in the *vimana* or shrine of the temple, which rises like a spire with a curvilinear outline and vertical divisions, and constitutes, like the Jainite spire, the prominent feature of the design.

The three Tamul states were Chera, Chola, and Pandya.

The first was insignificant; the second between the tenth and twelfth centuries conquered the other two, and sent troops to Ceylon and to Ellora; the third had periods of power, during one of which Madura was enriched in the seventeenth century with its best known monuments. Although antagonistic, the people of the southern part of the peninsula belonged to the same race; their architecture is different from all others, but is united in itself, and has gone through a process of degradation from the earliest times, until it was lost altogether in the last century. Ascending upwards, the thread of architectural history breaks just where something occurs so elegant and pure as almost to admit a comparison with some of the better specimens of classic art in more western lands. This, which FERGUSON mentions as emphatically the principal Hindoo style, is supposed by him, p. 130, to have been an adoption of Buddhist forms, or at all events to have arisen out of the same forms from which the Buddhists elaborated their style.

A temple consists of the *vimana* or shrine, and the *mantapa* or porch, with perhaps a *choultry* or pillared hall, situated in an enclosure with one or more *gopuras* or gateways; thus the description of a large temple is very like that of a Jainite temple, yet as FERGUSON has shewn they are essentially different in design; the Jainite shrine in the centre towers like a northern pagoda above the rest and is associated with a number of domes and smaller towers; while the Tamul temple is a collection of gateways, diminishing in size as they approach the central shrine, a storied pyramid, which is generally the least important feature architecturally of the temple. Even in the details, the same author sees the pure original at Mahavellipore; the degraded style in the Perumal pagoda at Madura; the Hindoo-Mahometan feeling in the hall of the palace at Madura; and the Italian details of the secondary temple at Tanjore.

The details of the northern, or Vishnite, style will be found in KIRTOE, *Illustrations*, fol., Calcutta, 1838; and those of the southern, or Sivite, style in RÂM RÂZ, *Essay on the Arch. of the Hindus*, 4to., London, 1834. It is to be regretted that the former author has not sufficiently indicated the locality or the date of the examples; and that the latter is supposed to have thought that the modern details were the best. FERGUSON, *Picturesque Illustrations of the Ancient Arch. of Hindostan*, fol., London, 1847.

HIND POST. The term sometimes given to the heel post of the stall in a stable. J. T.

HINGE (Gr. *γεργλυμός*; It. *ganghero*; Sp. *charnela*; Fr. *charnière*; Ger. *geuerbe*, *gewinde*, *scharnier*). The contrivance used for hanging doors, windows, lids, covers, etc. It is usually made of metal, in two pieces as a hook and eye; or as eyes receiving a pin to connect the two plates; the eyes forming the 'knuckle'. A pair of hinges is commonly employed to hang a door, one being near the top, and the other near the bottom; while a third is placed between them when the weight of the door is considered to be too great for a pair only. One flap or strap is fixed to the door post, the other on the edge or on the face of the 'hanging stile' of the door; the line in which the axes of the hinges are situate is called the 'line of hinges', and must be in one plane.

The hinges of the oldest buildings were made of wood, elm being considered the best, as noticed by PLINY, l. 16; c. 40. Another writer observes that those who wished to enter a door unheard, took the precaution of previously throwing water upon the wooden hinges, which prevented their creaking. They were often of brass, PLAUT. *Curcul.*, act i, sc. 3; and some of the enormous size of a palm (10½ ins.) in diameter, and weighing thirty or forty pounds, were found at Herculaneum, and are preserved in the Neapolitan collection. Specimens of ancient hinges are also to be seen among the bronzes of the British Museum. The lower part is a plate, in one instance about 4-10ths of an inch thick, having a small sinking of about 1-10th of an inch deep, to act as a socket and receive the upper cylinder, which was attached to the door; this cylinder is about

2½ ins. in diameter and 2-10ths thick, and seems to have covered a projecting knob, which formed part of the hanging stile. The Romans did not hang the doors from the jambs, but by pivots attached to the hanging stiles at top and bottom, working in sockets let into the lintel and sill. If the door was formed of two leaves (*bivalve*) one of which folded back upon the other, the hinges which connected the two leaves were strap hinges, like those now in common use, let into the solid and covered over with a veneer of wood or plate of metal, and thus concealed from view: the hinges of the hanging leaf turned upon a pivot, as described above, and the door was retained at top by the pivot working in the head of the *rame*; DONALDSON, *Ancient Doorways*, 4to., London, 1833, p. 9. CARDO; STROPHEUS; THAIROS.

During the mediæval period, the hinge for gates and doors was simply an eye fitting on a hook secured into the wall, the eye forming part of a long arm, strap, or plate of about ¾ in. iron extending across about three-fourths of the width of the door, and made either plain, indented, with a foliated end more or less ornamented, or with branchings of scroll work sometimes enriched with inscriptions: these scrolls were occasionally straps only, and not part of the hinge. The doors of Notre Dame at Paris exhibit the whole woodwork covered with foliated hinges, as given in GAILHABAUD, *Arch. du v au xvi siècle*, fol., Paris, 1854; and as at S. Luke, Hickling, Nottinghamshire, and Little Horstead, Hertfordshire.

Among the earlier notices of this useful invention are the following: 1329, "for two *vertinell* with two *gumphis* (hinges and latches?) for hanging the door of the inclosure, 8d."; and 1365-6, "two pair of *vertinell* ad *gumphis* for a window"; with "one pair garnetor"; one pair of gernetz; six pair of garnetts"; appear to be all the entries for hinges in BRAYLEY AND BRITTON, *Palace at Westminster*, 8vo., London, 1836, p. 192, 199: 1368-9, "for making divers ironwork, as well for the doors and windows—namely for rides (*gumpt*, hooks, or rides, as they are called in Kent, of the hinges which are fixed in the jambs of the opening), bands (*vertinell*, the straps or bands on the door), cramps, bands (*vinculis*), rings", etc., for works at Rochester castle, KENT ARCH. SOC., *Arch. Cant.* 8vo., Lond., 1859, ii, 125: 1582-5, 5-8 Richard II, twelve pair of lesser hooks and hinges (*hokes et hengyles*) bought for the small door and great windows of Rockingham castle; ARCHEOLOGICAL JOURNAL, 8vo., London, 1845, i, 372: 1505, "item for iiij peyr white henges (perhaps of *timed iron*) weying xxij lb., price lb. ij d.; for a peyr of blak hengys weying xv lb., price lb. 1½ d.", to be used at Henry VII's chapel; LAING, *Custom House*, fol., London, 1818, p. 39. *Illustrations*, s. v. Metalwork, 1850-51-61.

The hinges commonly used in the early part of the eighteenth century, were termed bed hinge, box hinge, dovetails (Sp. *bisagras à cola de pato*) hooks and hinges, side hinges, and screw hinges; besides butts, casement, esses, folding, garnet, lamb's heads, side, side smooth filed, side with squares, side with rising joints, trunks, scuttle, shutter, Lancashire of various sorts, etc.; with others named but not described. 4. 5.

I-L hinges, and those with rising joints, pew, shutter, side, dovetailed, were all sold at per pair; cross garnets with rising joints, at per dozen; cross garnets with filed joints, and hinges with hooks, at per cwt.; the commoner sorts, which are detailed, at per dozen; butt hinges are not named; SALMON, *Vade Mecum*, 8vo., London, 1755, p. 56-7. H-L hinges, and those with rising joints, butt hinges, and cross garnets, are only those noticed in CLAVERING, *Carp. and Joiner's Vade Mecum*, 8vo., London, 1776, p. 33-4: p. 19 he notices a rising hinge invented by E. Gascoigne, locksmith, formed of a strong wheel carrying the whole weight of the door, ascending in an inclined plane until the door was open to an angle of about 75°, when it would return and shut itself, but if opened beyond 75° it would fly open to 90°, requiring then to be closed by hand; when the door was shut the hinge was not seen: the price for each door was 2½ guineas per pair. The hinges which did not

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rise were 25s. per pair, the parts in contact being made of polished hardened steel working against hard bell metal.

Each description of hinge is noticed in the separate articles in this work; but the following short account will give a general idea of the various sorts, those at present used being classified as follows:—

A. *Hinges fixed on the front of a door.* The simplest form is a hook and eye, or a hook and band, consisting of a flat iron bar screwed to the face of the door with one end turned into a ring which works round a hook fixed in the jamb. A heavy gate is best hung upon a pivot secured to the heel of the hanging stile and working in a metal cup let into the sill, the upper hinge is then inverted so as to offer no unnecessary friction as the pivot wears away. Collinge's hinges combine these two principles. A modification made in the form of the working part, by substituting a knuckle for a hook and eye, produces the cross garnet, and the following other hinges, which are designated from their similarity to the letters of the alphabet, viz. T hinge; S hinge, which during the middle ages was ornamentally wrought for the lids of cope chests and for cabinets; H hinge; and H-L hinge. The water-joint hinge consists of two bands of iron terminated in welded rings interlocked; it is used for cellar flaps, ash-bins, and other horizontal doors exposed to the weather, because the working parts are not liable to become fixed by rust. Back flaps (*Fr. coulplets*) and table hinges are made of brass and iron; when of the latter metal they are wrought, or cast, or stamped, or pressed and rivetted.

B. *Hinges fixed on the edge of a door.* These come under the generic title of "butts", but are of various kinds and are made of copper and brass, also of wrought, cast, or stamped iron. The ordinary butt hinge (*Fr. fiche à doubles nœuds*; *Sp. quicio*) varies from half an inch to 6 in. in length measured along the knuckle; it is composed of two interlocking portions fitted into each other and secured together by a stout wire or pin firmly rivetted, which is the axis of the hinge. A lifting butt consists of two pieces of equal size and shape resting upon each other, the wire axis being rivetted to the lower half only; doors hung with these butts (*Fr. fiches à vases*) may be removed with facility.

Parliament butts project considerably beyond the face of the door or shutter, and are employed when it is hung within a reveal, for the purpose of causing it to lie flat against the face of the wall when opened. The pew butt or egg butt has the projecting knuckle made oblate, so as to prevent the possibility of its catching persons' dresses.

Rising butts or skew butts differ from common butts, because the portions work in an oblique plane and therefore cause the door to rise above the floor so as to clear a carpet; the best hinges of this description are brass tubed and plated; other expedients are, however, resorted to for the same purpose, such as laying a lath upon the joists immediately under a door before the floor is laid; or fixing the axis of the lower butt at a greater distance from the face of the door than the upper butt; when the door, though a parallelogram, opens as a trapezoid. Rising butts are also made with two oblique planes in each, they are then called double rising butts; when hung with them a door may be left open at will.

C. *Self closing hinges.* All rising butts have a tendency to close, and will do so if the weight of the door is sufficient to overcome the friction of the working plane. A gooseneck hinge consists of a hook and band applied near the bottom of a door, so that the hook projects considerably beyond the upper hook, and the end of the band forms a quadrant beyond the face of the door. A spring butt consists of a metal tube firmly fixed to the side of the butt and inserted in a hole bored in the edge of the door; the tube containing a spiral spring pushing against a chain fixed to the opposite cheek of the butt. For keeping swing doors closed at right angles to the jamb, a double acting spring butt or folding butt may be

used; it is formed of three plates of metal connected by two knuckles at opposite sides and drawn together by two spiral springs. Floor springs are cast iron boxes containing the pivots upon which swing doors are hung, strong springs being placed therein to press upon an arm or cam fixed to the pivot.

Sympathetic hinges consist of pivots running above or below folding doors connected together by a bar working with cranks, so that if one leaf be opened the other opens with it; but these are very dangerous to those persons unaware of the peculiar action.

d. Fancy hinges. This is the trade term for any hinge not previously defined; they are innumerable and follow the whim of the workman or designer, or the speciality for which they may be intended; concealed butts, coach butts, stop butts, chest hinges, scuttle hinges, hinges with moulded knuckles and concealed joints, double acting rising hinges with springs, all come under this designation.

A paper on *Hinges in common use*, read by RICKMAN before the Architectural Association 1859, is given in the *BUILDER Journal*, xvii, 589; and in the *BUILDING NEWS Journal*, v, 1173. The *PENNY CYCLOPÆDIA* refers to HEBERT'S *Engineer's and Mechanic's Encyclopædia* for full details of the usual sort of hinges; and notices Collinge's, and Redmund's, patent hinges for heavy doors and gates; Whitechurch's patent hinge by which doors or windows can be opened either on the right or left hand; and Nettlefold's hinge for doors of book-cases, by which two adjacent doors opening in contrary directions may be hung without an intervening style—the doors thus folding completely back. Among the innumerable inventions for hinges are: Stone's double swing door spring (*SOCIETY OF ARTS Transactions*, 1814, xxxii, 174); hinges to keep a gate shut (*CIVIL ENGINEER Journal*, vii, 300); a swing centre or trough hinge; a bottom hinge for a gate opening both ways; Gerish's single action butt hinge, and double action butt hinge for doors opening both ways; Imray's patent cup and ball hinges and butts; Beattie's new patent air spring for shutting doors, etc. (*CIVIL ENGINEER Journal*, xiii, 175, 295); etc., etc. NICHOLSON, *Arch. Dict.*, contains a long article with illustrations on "Hingeing".

2. 5. 14.

HINGE STILE, see HANGING STILE; and CARDO.

HINGE STONE. The stone in the jamb of a doorway of a mediæval building, into which the hook of a hinge is let in and run with lead. It is also so called when built in a pier, etc., for the hinge of a gate.

R. R. R.

HINO WOOD is noticed in the *BUILDER Journal*, 1846, iv, p. 445, as a beautiful wood for furniture and interior decoration. Specimens cut from the root were of a dark brown colour; it veneers and polishes well and could be then obtained for £25 per ton.

HIORNE (FRANCIS), F.S.A. (7 Apr. 1784), born 1741 at Warwick, was one of the early practitioners of the revived Gothic architecture. He built 1760 the vestry and lobby at the east end of the north aisle of S. Martin's church, Birmingham; Foremark, Derbyshire (Italian), for Sir Robert Burdett, bart., given in WOOLFE and GANDON, *Vit. Britt.*, fol., London, 1771, ii, pl. 31-5; at Warwick, the county gaol with the county sessions house, the gate, and the town hall, all commended for their convenience and the simplicity and good taste of their architecture; 1776 the church at Stony Stratford; the offices to Goppeshull or Gopsul Hall near Leicester, for Penn Ashton Curzon, esq., the house being by — Westley of Leicester (THROSBY, *Leicester*, 4to., Leicester, 1789-90); before 1786 a triangular tower in the Home-park, at Arundel Castle, Sussex, for the duke of Norfolk, he suggested several of the improvements at that castle, "having a very just conception of the genuine style of the Gothic military architecture" (DALLAWAY, *Western Sussex*, 4to., 1830-2, ii, pt. 1, 188, 192); and he built a church (fifteenth century Gothic) at Tetbury in Gloucestershire. He died 9 December 1789, aged 48, and was buried in S. Mary's church, Warwick, where a tablet to his memory

exists on the south side of the chancel. *GENTLEMAN'S MAGAZINE*, 1800, lxx, 1144-5 (1052).

W. P.

HIORT (JOHN WILLIAM) was born 16 April 1772 in London. He entered the office of C. A. Craig 1 Jan. 1787; was appointed by Sir W. Chambers professional clerk in the board of works; promoted to chief office clerk by royal sign manual 16 May 1799; and to third board officer 5 Sept. 1805, succeeding R. Brettingham. When the business of the board was transferred to the office of Woods and Forests in 1832, after forty-five years service he was superannuated. He designed the floating bath used at Weymouth in 1792 by king George III; 1806 arranged the public funerals of Mr. Pitt and of Lord Nelson; 1809 assisted J. Wyatt in the preparations for the festivities at Frogmore when king George III entered the fiftieth year of his reign; strengthened the bridge in S. James's-park, designed by J. Nash for the jubilee of 1 Aug. 1814; and supervised the reception room, also designed by J. Nash, for the festivities at Carlton House, 120 ft. in diameter, with 24 sides (re-erected at Woolwich as the model room, and lately rendered more substantial; HUNT, *Tudor Arch.*, 4to., London, 1836, p. 97, says it "was designed or invented by, and executed under the direction of, the late William Nixon"; valued the Claremont estate near Esher for princess Charlotte of Wales on her marriage; and as architect to her highness he designed the new lodges in the Cobham-road; alterations to those next to Esher; the ornamental labourers' cottages; the moss seat; the conservatory; the coach house and stables; the kennel; the aviary, etc.; and the 'retreat', in a Pointed style, which on her death was formed into a chapel or cenotaph (ACKERMANN, *Repository of Arts*, 8vo., London, 1819, p. 154; FORGET-ME-NOT *Annual*, 12mo., London, 1824, pp. 36, 314); and contrived the apparatus (the first of the kind) for lowering into the vault the coffin of the princess at her burial November 1817 in S. George's chapel, Windsor. In 1820 for the coronation of king George IV, he designed the triumphal arch, orchestra and connecting galleries in a Pointed style; with all the internal and external accommodation for the banquet at Westminster hall; the numerous temporary buildings occupying the whole of Cotton Garden required for the culinary department; the pavilion, stable, etc., for the champion; with the serpentine gallery prepared for instant enclosure in case of bad weather, extending from the north door of the hall to the west door of the abbey church, (some parts of these are given in NAYLER, *Coronation*, fol., London, 1824); and about 1821 he effected at Westminster hall the reinstatement of the lantern or louvre in the roof, the weight being calculated at 11 tons, with the restoration of the north and south walls (commented upon by [BUCKLER], *Observations — on Magdalen College*, 8vo., London, 1823, p. 177). Before the regulations were introduced for the whole of his time being given up to the king's service, he had designed 1799, Dderw, at Rhayader in Radnorshire for N. S. Prickard, esq., the bricks being the first made in that locality; the building is now much altered: considerable works for Lord Bexley at North Cray in Kent; and at Great George-street, Westminster: for colonel Eliot in Old Burlington-street: and at the residences of Chas. Arbuthnot, esq.; and of alderman John Johnson.

He invented and patented, 8 Nov. 1825, bricks for building circular flues of 10, 12 and 14 ins. diameter, without any labour of cutting, and terminals for preventing smoky chimneys; on this system upwards of 2000 flues were constructed before the adoption of cheaper materials rendered necessary the abandonment of the manufacture. To explain this system he published *Practical Treatise on the Construction of Chimneys*, etc., 8vo., London, 1826; and formed the London, Surrey and Kent Safety Brick Company, to carry out these and other inventions, as floor tiles to supersede sound boarding and pugging; chimney bars to prevent the smoke creeping under the mantle; safety bricks for building hollow walls of 9 ins. thickness and upwards; stove grates to avoid smoke, etc.;

all described in the Company's *Descriptive Catalogue of Models*, etc., 12mo., London, 1833. These inventions were used at many public buildings and in private mansions; amongst which were all the new chimneys at Buckingham palace under J. Nash; by Sir Robert Smirke at Lord Manvers' house, Portman-square; and the upper apartments of the new post office, etc. PASLEY, *Outline of a Course*, etc., 4to., Chatham (lith.), 1826, has devoted pp. 218-28 to a detailed explanation of the system.

After many years of retirement at Bath, he returned to London in 1847, and endeavoured to readvocate some of the above inventions as adapted to modern requirements, in a *Report of the Aeronomic Association*, 8vo., London, 1852: he was enabled for some time to carry out many of his views with great success at some of the government offices. He died at Bedford-place, Kensington, 8 Feb. 1861, aged nearly 89 years, and was buried in Kensal Green cemetery. Autobiographical Memoir, privately printed; and given in *BUILDING NEWS Journal*, 1861, vii, 460. GAYFERE.

HIP (Fr. *croupe*). When the gables of a roof are not carried up, but the plates are continued round, and the roof slopes forward or backward to the ends as well as to the sides, it is said to be hipped, and the line of intersection of the sloping sides or external angle is called the 'hip', in contradistinction to a similar junction of roof planes which form an internal angle or 'valley'. The hip is called 'piend' in Scotland. A. A.

A hip roof has neither gable head, shread head, nor jerkin head. Some persons call such a roof 'an Italian roof'. 4.

HIP BEVEL. The angle which two adjacent sloping sides of a roof make with each other taken at right angles across the hip. The method of finding this is given in NICHOLSON, *Carpenter's New Guide*, 4to., London, 1805, p. 56. A. A.

HIP HOOK, or **HIP NAIL**. A species of large nail with a hooked head, put into the hip of a roof to keep the hip tiles in their places. A. A.

HIP KNOB (Fr. *épi*). A finial, ball, or other ornament at the intersection of the hip rafters and the ridge. It is sometimes confused with the gable knob, which it generally resembles, but which is fixed at the intersection of the outer rafters or barge boards of a gabled house. The *Illustrations* (pl. xc, 1851-52) give many specimens of the hip knob, chiefly from Rouen, which with the descriptions are taken from DELAQUÉRIÈRE, *Essai sur les girouettes, épis*, etc., 8vo., Paris, 1846: SIRODOT, in DALY, *Revue Générale*, 4to., Paris, 1855, xiii, pl. 2, pp. 5-10, gives colored examples in terra cotta from Troyes. CLUTTON, *Domestic Arch. of France*, fol., London, 1853. CROP; FINIAL; RIDGE. A. A.

HIP MOLD. A mold used by carpenters to scribe the angle of junction of the jack rafters and the hip. The method of finding it is given in NICHOLSON, *Carpenter's New Guide*, 4to., London, 1805, p. 56. HIP BEVEL. A. A.

HIPPED ROOF (Fr. *toit brisé, en croupe, en arête*). A roof sloping each way to the plates. A. A.

HIPPIAS, is noticed by LUCIAN in *Ἰππίας ἢ Βαλανεῖον*, as one of his contemporaries, and as being amongst those who united the theory and practice of the art, as a geometrician, mechanic, astronomer, musician, architect, and a builder of baths. He flourished cir. 140 A.D. 5. 25. 117.

HIPPOCASTANUM, the horse chesnut, see *ÆSCULUS*.

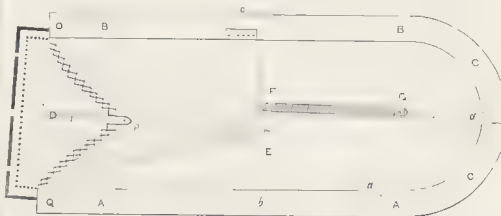
HIPPODAMEIUM. An adjective derived from *HIPPONAMUS*, and applied by the Greeks to a city built on a regular plan, and to the public places and buildings in them. 59.

HIPPODAMUS (Gr. *Ἱππόδαμος*), born at Miletus, flourished during the second half of the fifth century B.C. He was invited by Pericles to lay out the Peiræus near Athens, the fortifications of which had been begun by Themistocles. He was the inventor of a system called *ῥυμοτομία*, viz. the introduction of broad straight streets crossing each other at right angles, in lieu of crooked and angular ones. He followed the Athenian colonists who went to found Thurium on the ruins of

the ancient Sybaris, B.C. 443, and was architect of the new city. About B.C. 408 he also constructed the city of Rhodes, on the same principle of uniformity and regularity. HERMANN, *Disputatio de Hippodamo Milesio*, 4to., Marbourg, 1841; MULLER, *Attika*, in ERSCH and GRUBER, *Encyklopædia*. 112. 117.

HIPPODROME (Gr. *ἵπποδρόμος*). The place appropriated by the Greeks to horse-races and chariot-races. The chief points of difference between it and the *CIRCUS* of the Romans was the smaller width of the latter, in which only four chariots ran at a time; and the peculiarities attending the *carceres*; for as seven, ten, or more chariots contended in the Greek games, the arrangements at the starting-place were more complicated than in the Roman system. *CARCER*. In this Dictionary it seems unnecessary to speak of the details of these sports, but to refer the reader to the account given by HOMER, *Iliad*, xxiii, and to the numerous allusions contained in PINDAR, in ARISTOPHANES, and other writers. A description of the famous hippodrome at Olympia is given in PAUSANIAS, lib. vi, cap. 20, and from this the supposed plan has been made by de la Borde, and by HIRT, *Geschichte der Baukunst*, 4to., pl. fol., Berlin, 1821-27, pl. xx, fig. 8, given by SMITH, *Dictionary of Classic Antiquities*, s. v. Hippodrome.

It appears this hippodrome (or stadium as it has been called by some writers, though properly the stadium is smaller and intended for foot races only) was set out on the slope of a hill, and constructed by a process familiar to engineers as a side-long cutting: one of the lines, A A, on which the spectators stood or sat, being the embankment or the formation



of the excavation; while the other, A A, was cut out of the side of the hill. C C is the semi-circular end called the *σφενδάνη* or sling, so named because the bottom of that weapon is round; this is a form common both to Greek and Roman race-courses; D is a *stoa* or portico, called that of Agnamptus by PAUSANIAS (which word literally means without curve), but whether this was applied because the portico was straight, or whether Agnamptus was the name of a person does not appear. He states that at the end of the hippodrome was the *ἄφεσις* or starting point. He then describes this *ἄφεσις* to be in form like the prow of a ship, the beak *ἔμβολον* projecting into the course. The *ἄφεσις* was full of stalls *οἰκίσματα*; and it will be seen from the plan that as the chariots all drove for the point E, and went round the course on the right hand side, those at points O and Q could have had little chance against the one starting from P. But this was compensated thus. Each stall had a rope across the opening instead of the sort of trap used at other places, *καλῶδιον ἀντὶ ὑσπληγγος* (the latter word signifies a bird catcher's trap, THEOCRITUS, viii, 56). This was thrown off first at the extreme stalls O and Q, and as soon as that chariot emerged the rope was cast off the next pair, and so on that the start might be fair. This arrangement, it is stated, was the invention of Cleotas the son of Aristocles, probably the sculptor referred to in lib. i, cap. 24; and then it was afterwards modified by Aristides, supposed by Böckh, *Corpus Inscript.*, i, p. 39, also to have been a sculptor. Pausanias then says each side of the *ἄφεσις* was more than 400 ft. in length, so that the width of the hippodrome must have been about the same, as the triangle seems to have been nearly equilateral. He does not mention the whole length, but merely says that one side was longer

than another. This no doubt was done to accommodate the starting point, as shewn on the plan. But if the statement of PLUTARCH, *Sol.*, 23 be considered, that the ἵππικὸν was a course equal to four *stadia*, and as they went round twice, it seems clear the distance between the two goals *γ* and *ε*, which he calls *ύστασι*, must be one stadium or about an English furlong. One of these goals, he states, was called *ταράξιπη*, or the terror of horses, probably as it was a dangerous turn; and on the other was a statue of Hippodameia presenting the victor with a fillet; this most likely was at the winning line *γ*.

PAUSANIAS mentions another altar surmounted by a brazen eagle and a dolphin of the same metal, raised on the end of the ἑμβολον, or beak of the prow of the ἀφesis. These he says could be raised up and let down by machinery, and were probably used as signals. HIRT shews on his plan a *spina* between the goals, but there is no mention of such a work. At *a* was a place where the priestess of Ceres and other great personages sat, and at *c* was the ἑλλανοδίκαι or judges of the games. At *b* was a place of egress for any chariot which might be injured and wish to get out of the way of the others; and at *d* was another opening resembling the *porta triumphalis* of the Romans.

On reference to the woodcut in the article *CIRCUS* in this work, it will be seen that the chief difference between this and the Grecian hippodrome was first the greater width, a necessity as the Romans had only four chariots at a time in the circus; but in SOPHOCLES, *Electra*, 701, *et seq.*, the teacher reckons ten chariots at the Δελφικῶν ἁθλῶν, the Pythian games, which ranked lower than the Olympian. The next difference is the disposition of the starting point. The Roman plan was far more simple, and the start must have been better effected. Instead of horses being kept chafing against a rope, and confused by the crowd of spectators and then released a few at a time; it is known (from a bas-relief now at Velletri and figured by SMITH, p. 2852), that the *carceres* were shut in by close doors and opened at once by several men who appear each to be pulling at a sort of catch, probably the *υσπληγξ*. There does not appear to have been a *spina*. In the two instances taken by SMITH from PANOFKA, the goals are shewn as plain short columns and no wall or division between. The Romans made seven circuits, the Greeks but two. The signals seem to have differed. The chief difference in construction was, that the Grecian hippodrome was of earth with the exception of the *stoa*, while all those found in Italy are solid constructions of brick and masonry. Several other hippodromes are incidentally mentioned, but there is no description of them. The so-called hippodrome at APHRODISIAS in Asia Minor is a *STADIUM*.

From PLINY, lib. v, ep. 6; and from MARTIAL, lib. xii, 50 and 57, it appears that the Romans had hippodromes attached to their private houses, but it seems on examination that they were only 'rides' or exercising places, bounded by *viridaria* or ranges of shrubs, particularly the *boxus*, and not architectural constructions.

Many modern buildings have been erected called 'hippodromes', but they are rather for the exhibition of equestrianism, or horse theatres than places for racing. In fact the present system is so entirely different from that of classic times, that a parallel cannot be drawn. They are very often temporary erections, and even when permanent as at Paris, they are circular erections open to the sky, surrounded with seats like those of a pit, with boxes behind them, and are more allied to the Roman amphitheatre than the Greek hippodrome. A. A.

HIPPOMANE MANCINELLA, the manchineel of the West Indies and South America. It is a large tree, the wood of which possesses some of the general characters of the mahogany and is similarly used, but it is much less common. It is described as yellow brown in colour, beautifully clouded, and very close, hard, and durable. The juice is a deadly poison. The bastard manchineel is the produce of *Cameraria latifolia*; HOLTZAPFEL, *Woods*, etc., 8vo., London, 1843, p. 93.

HIP RAFTER (Fr. *chevron d'arétier*). The rafter reaching from the ridge to the angle of intersection, or mitre of the plates. It is generally of 1½ or 1¾ in. stuff. The short rafters which pitch against this are each called a JACK-RAFTER. For the methods of finding the lines for all these, see the preceding articles; and EMY, *Traité de la Charpenterie*, 8vo., Liège, 1841, p. 482; and other works quoted *s.v.* Carpentry. ANGLE RAFTER.

A. A.

The hip or hip-rafter has commonly five planes, the common rafter having but four. In some parts of the country it is called 'corner'; in others 'principal rafter'; and also 'sleeper'; but the sleeper, properly, lays in the valley and joins at the top with the hip: those planes which make the 'back' of a hip, form the underside of the sleeper. BACKING; BACK OF A HIP.

4.

HIP ROLL. A piece of stuff from 1½ to 2 ins. diameter, worked like a rounded ridge and nailed on the 'hip rafter'; over this lead is placed and secured to it.

A. A.

HIP TILE. The name given to the tile that covers the hip, when lead is not used. These are sometimes simple ridge tiles, but in some countries, as in Sussex, hip tiles are made on purpose smaller at one end than at the other, so that they lap over each other, and avoid heading joints. The lowest hip tile, and frequently the others are generally secured by a HIP HOOK. VALLEY TILE.

A. A.

HIRAM and HURAM; Hiram Abiff or Adoniram, according to the legends of the Society of Free and Accepted Masons, was the superintendent of the works at the building of the temple of Solomon at Jerusalem, cir. 1015-05 B.C.: but I Kings, vii; II Chronicles, ii, only describe his works as being those cast in brass; and I Kings, v, 14, ADONIRAM (Adon, lord, and Hiram), was the chief of those sent to Lebanon for timber for the temple.

HIRTON (ROGER DE). The second known master mason employed at the building of York cathedral. SURTEES SOCIETY, *Fabric Rolls*, 8vo., Durham, 1859, p. 161-4, contains the following record of him; "Nono die Januarii 1344: . . . Item dicit quod solvit semel Rogero de Hirtone ejusdem fabricæ cementario, stipendium suum fere per quindenam, qui toto tempore illo absens fuit, et nichil operabatur. Item de pecunia soluta pro potacione . . . Magister cementariorum comparuit xj die Janr., anno etc., xliiij^o." The masons became idle, and idleness generated strife and plunder among them. Willelmus de Wrsal was the "submagister operis fabricæ".

HISPALIS or ITALICA, the ancient names of SEVILLE, in Spain.

HISTORICAL COLUMN, see MEMORIAL PILLAR.

HISTORY OF ARCHITECTURE. As the variations of a style in all countries, and of styles in a country, have been treated in separate articles in this Dictionary (*e.g.* DECORATED, and FRENCH), on the present occasion a list of the treatises on the history of styles in all countries may suffice. Amongst the earliest to attempt such a work were QUATREMÈRE DE QUINCY, *Dict. Hist. de l'Arch.*, 4to., Paris, 1788-1820, reprint 1832; LE GRAND, *Essai*, prefixed to DURAND, *Recueil et parallèle des édifices publics de tout genre ancien et moderne*, fol., Paris, 1801-9; WIEBECKING, *Architectur civile theorique et pratique*, fol., Munich, 1821-26: to which might be added HOPE, *Historical Essay*, 8vo., London, 1835; and the articles on architecture in various dictionaries, especially that in the ENCYCLOPÆDIA BRITANNICA, by HOSKING, 4to., Lond., 1832; that in the ENCYCLOPÆDIA METROPOLITANA by NARRIEN, 4to., London, 1845; and that in the ENCYCLOPÆDIA LONDINENSIS, by TREDGOLD, 4to., London, 1810. It seems exceptional to name DUNLOP, *History*, 8vo., New York, 1834, because it relates only to the United States, but it must be taken with TUTHILL, *History*, etc., 8vo., Philadelphia, 1848; and LEFEVRE, *Architectural Instructor or History*, 4to., New York, 1856, as instalments of a supplement not only to the works above mentioned, but to those which follow. VENDRA-

MINI, *Précis historique et raisonné*, 4to., S. Petersburg, 1837; GWILT, *Encyclopædia*, 8vo., London, 1842, and supplement, 1851; GAILHABAUD, *Monuments anciens et modernes*, 4to., Paris, 1842-50, and, as a supplement, *Architecture du moyen âge et de la renaissance*, 1850; RAMÉE, *Manuel de l'histoire générale de l'A.*, 12mo., Paris, 1843, and edit. 8vo., Paris, 1860-2; BATISSIER, *Histoire de l'art monumental*, 8vo., Paris, 1845, 2nd edit. 1860; FREEMAN, *History of Architecture*, 8vo., Lond., 1849; GODWIN, *History in Ruins*, 8vo., London, 1853; FERGUSON, *Illustrated Handbook*, 8vo., London, 1855-64; LUEBKE, *Geschichte der Architektur*, 8vo., Köln, 1858; and KUGLER, *Handbuch der Kunstgeschichte*, 8vo., Stuttgart, 1843, with the supplement of illustrations by VOIT, GUHL, CASPAR, and LUEBKE, *Denkmaeler*, fol., Stuttgart, 1845-56; HUGGINS, *History*, with a chart, 8vo., London, 1863; STIEGLITZ, *Geschichte der Baukunst*, 8vo., Nuremberg, 1827.

Histories or accounts of the construction of buildings are very scarce; the earliest is that by Gervase of the burning and rebuilding of CANTERBURY cathedral in 1176; and that by Wanda of the building of SALISBURY cathedral in 1220; SMEATON, *Eddystone Lighthouse*, fol., London, 1793, should be noticed.

HIT AND MISS WINDOW. An arrangement of window adopted for lighting and ventilating stables; the upper half of it is an ordinary fixed sash, and the glazing is protected next the stable by light iron bars. The lower part of the sash frame is filled in with two framed wood gratings $1\frac{1}{2}$ in. thick; the outer grating is fixed, the other moves in a groove behind it. The bars of the movable grating must be a little wider than the openings of the fixed one, so that they may effectually *hit*, or cover the openings; they can be placed to *miss* at pleasure, thus any amount of ventilation may be obtained.



R. R. R.

HITCHCOCK (JOHN THOMAS) was born at Amsterdam in 1812. He went to London when quite young, remained there eight years, became a pupil of P. Hardwick, and travelled two years in England. He then returned to Amsterdam; left for Java in 1841, where he settled, and died at Batavia in 1844. He built the clubhouse *Vriendschap*, at Amsterdam; a house near Haarlem; and others in the vicinity of Arnheim, Soestdyk, etc.

24. 101.

HITCHENDON HEATH STONE, see HEATH STONE.

HITTERDAL. A village in Telemark in Norway, situate near Søm, on the road from Døl to Bergen, containing one of the oldest timber churches in that country; it is given in DAHL, *Denkmale—Holzbaukunst*, 9 pl. fol., Dresden, 1837. It was restored by the association for the preservation of the memorials of Norwegian antiquities in 1850-1, under the direction of the architect Nebelong, at a cost of about £750, but the modern ceiling was permitted to remain; *ECCLÉSIOLOGIST Journal*, 1858, pp. 52-3. Illustrations of its three doors are given in WEALE, *Quarterly Papers on Arch.*, 4to., London, 1843-5; and a small view by the Royal Institute of British Architects, *Transactions*, 4to., London, 1842, p. 189; and DALY, *Revue Générale*, 1856, xiv, p. 22. BORGUND.

HKLAMOORG ARADJI, or TILIA VULGARIS. A wood of Turkey used for carving and fine work.

71.

HOARD. A peculiarly English term, said by PARKER, *Buildings of Gundulph* (in GENTLEMAN'S MAGAZINE, 1863, ccxv, p. 258; and BUILDER JOURNAL, xxi, 564) to be evidently borrowed by the French in the word *hourd*, a gallery or scaffold projecting beyond the face of a wall, and illustrated by VIOLETT LE DUC, *Architecture Militaire du Moyen Age*, 8vo., Paris, 1858. It is usually applied to a temporary enclosure put up to guard a plot of ground or a building, or the site of any underground operation. The hoarding is generally made of planks; while in any rough or cheap jobs, any old materials are worked in. Prices for hoards,

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fans, and shoring, in the new street in Southwark, are given in BUILDER JOURNAL, xvii, 19 Nov. 1859 (adverts.).

REGULATIONS FOR HOARDS AND SCAFFOLDS,
as agreed to by the commissioners of sewers of the city of London,
15 Nov. 1864.

1. That no license for a hoard or scaffold be granted for more than two months.
2. That no hoard or scaffold project into the carriageway of any street without especial reasons, which should be stated on the license.
3. That no scaffold be enclosed so as to prevent passengers passing under it; but that the lower stage of all scaffolds be close planked, and proper fans and edgeboards be put out from the same, and any such additional precautions adopted as may in the opinion of the inspector of the district be requisite for the safety of the public.
4. That no materials be deposited beneath any scaffold, but that if it be necessary for the public safety to enclose a scaffold, or to place materials under it, it shall be licensed as a hoard.
5. That no hoard be allowed to project further than the feet of such raking or other shores as may be necessary for the safety of the building and of the public, nor for the erection of any new building, more than 6 ft. where the foot pavement is wide enough to admit of such projection; nor beyond the extent of the footway pavement in narrow streets, unless in cases of especial emergency, which shall be stated upon the license.
6. In all cases where it may be safely practicable or needed, a boarded platform 4 ft. in width, with a stout post and rail fence outside, or of such width and dimensions, and with such openings as the inspector of the district may require, be constructed in front of every hoard.
7. That box-boards be subjects of especial license.
8. That when licenses are granted for hoards in front of buildings about to be pulled down, proper fans for the protection of foot passengers shall be required to be formed.
9. That all platforms or projections beyond the line of curb shall be watched and lighted at night.
10. Scale of charge for licenses. For hoards, to remain not more than two weeks, 6d. per ft. lineal; for two to four weeks, 1s.; for four to eight weeks, 1s. 6d. For scaffolds, to remain not more than two weeks, 4d. per ft. lineal; for two to four weeks, 8d.; for four to eight weeks, 1s. The charge for each raking shore, for four weeks or less, 6s.; and for four to eight weeks, 10s.

HOB. The level surface formerly provided on each side of a firegrate, to receive kettles or other like utensils. It is now usually retained only in the grates and cooking stoves for kitchens and sculleries; and in the 'elliptical' grates of houses of humbler description. It is also called 'hud', and 'hood', in Yorkshire.

HOBAN (JAMES) of Washington, in the United States of America, gained the premium for the plan of the president's house in that city; and was engaged in that and other public works in 1800, when R. Mills became his pupil. DUNLAP, *Arts of Design*, etc., 8vo., New York, 1834, ii, 221, 467.

HOCES (JUAN), *baumeister*, worked 1472-8, together with P. de Toledo, F. Rodriguez, and others, at the cathedral of Seville, in Spain. CAVEDA, translated by HEYSE and KUGLER, *Geschichte der Baukunst*, 8vo., Stuttgart, 1858, p. 219. 66; 68; 116.

HOD. An implement used by bricklayers' and plasterers' labourers, for the purpose of carrying materials, such as bricks, mortar, etc. It consists of a long handle having at one end a kind of open box with two sides and one end, fixed on edge. The box is 1 ft. 4 ins. long, by 9 ins. on the sides, containing 1,296 cubic ins.; and will hold twenty bricks. Thirty hods are reckoned as one load, or a cubic yard, of mortar; the *Price Books* stating only twenty-seven; the actual quantity being but a thirty-sixth part. Some books state that the hod is 1 ft. 2 ins. long, the cubic quantity as 1,134 ins.; 2 hods = 1 bushel of mortar; 4 hods to suffice for 100 bricks; and 180 hods or 96 bushels of mortar to build a rod of brickwork. The term as now used would appear to be of modern origin; as in 1736 a hod is described as 'a sort of tray for carrying mortar.' BACK BASKET.

VIRLOYS, *Dict.*, describes the Fr. *holte*; It. *sporta*; Sp. *gabilla*; and Ger. *trag korb*, as an osier basket, higher than wide, placed on the back of a workman with fastenings round

his shoulders, and ordinarily used in works to carry earth, plaster, and other materials.

HODGKINSON'S GIRDER, see GIRDER, p. 38-9.

HOEFELICH (KLAUS), see HANS of Salzdorf. NAGLER states that a Klaus Hoeflich was employed on the same building at Nördlingen with other *baumeisters* 1495-1508; but the authority is not given, and these dates may not be correct.

HOELZER (GOTTLIEB AUGUST), born 1744 at Dresden; was instructed in architecture by Locke and Krubsacius. He was appointed assistant teacher at the academy of architecture in that city, and was afterwards employed to conduct the building of the new *Land und Steuerhaus*; in 1786 he became *hof-baumeister*, having been previously admitted a member. He designed a house for Count Vitzthum at Dresden; his designs for the tower, as well as for the interior decorations of the *kreuz-kirche*, were approved by the elector (the tower is said to have been erected by C. A. Exner). His pupils were numerous. He died at Dresden in 1814. 68.

HOERDE (HANS VON) finished in 1490 the münster or püssinakirche at Herford in Prussia. 68. 92.

HOESCH (HANS) of Gmünd, wrote in 1472 *Geometria Deutsch*, a treatise on architectural geometry, which has been printed in HEIDELOFF, *Die Baukulten*, 4to., Nur., 1844, p. 95-9.

HOFFMANN (HEINRICH) erected many buildings in Prussia, and entered 1710 the Russian service as a military architect. His brother JOHANN HEINRICH, also a *baumeister* and mathematician, was a member of the Royal Society of Sciences in Prussia. 68. 69.

HOFFMANN (NIKOLAUS), *baumeister*, finished in 1554 the Marien kirche at Halle-on-the-Saale, in Saxony. 92. 116.

HOFMANN (HEINRICH) was about 1613 *baumeister* and professor of mathematics at Jena; and also *hofmathematikus* at Weimar, where he designed the stone bridge. At Roda, a small town near Jena, he built the tower in the middle of the church to save expense. 69.

HOG-BACKED. The term used by common work-people for the rise purposely made in the centre of any very long line, such as the ridge of a barn roof; without this precaution, it will, when completed, have the appearance of settling down in the middle of its length; or it is a provision for actual settlement which would otherwise be accompanied with deflection. CAMBER. SCAMILLI IMPARES.

HOGGIN or HOGGING. The term used by workmen for the curved form given to the cross section of a roadway to throw off the surface water. AGGER. BARRELLING.

Hoggin is the term applied to the siftings or screenings separated by a sieve or screen of say 1 in. mesh (being finer or coarser according to the mesh) from the stones of rough pit gravel; and which is used for footpaths while the stone or 'ballast' is used for the carriage-ways. J. W.

HOGHTON TOWER, situate about midway between Preston and Blackburn, in Lancashire, indicates the locality of one of the most useful building stones in that county. It is a good clean uniform coloured stone of two or three degrees of fineness, the best of which takes a good polish. J. S. P.

HOG STYE, see STYE.

HOHENBERG (JOHANN FERDINAND VON), see HETZEN-DORF (J. F.)

HOHENBERGER (WERNHER) of Ratisbon erected 1423 the bridge before the Jacobs-gate of that city. OFFELE, *Rerum Boticarum Scriptores*, fol., Aug. Vind., 1763, ii, 312. 68.

HOIST. The name given to the machinery that has lately been introduced into building operations for the purpose of raising materials to the heights required in the construction. It is either moved by steam power, by horses, or by men. When the latter are employed, the weights lifted at one time must be regulated by the speed at which they are required. The horse run, which is more generally used, is formed of a level pathway, in which a horse moves, and draws up the load by the intervention of snatch blocks and guide wheels; this mode

of hoisting is expeditious and economical, and answers very well when the maximum weight to be lifted does not exceed 10 cwt.; for lifting loads beyond that weight a steam engine is generally used. G. R. B.

Dr. Spurgin's patent hoisting machine for raising bricks, etc., was used in 1843 by Messrs. Grissell and Peto, and T. Cubitt, as detailed in *CIVIL ENGINEER Journal*, vi, 302; and *BUILDER Journal*, i, 298, 346-7: in the latter work is given Johnson's builders' and contractors' hoist, xviii, 194, 236; note, 495; and xix, 400. Ager's patent hoist was advertised with a large illustration about the year 1860. These are the ladder-like hoists now in general use on large works. Harman's tubular framed hoist for heavy weights is shewn in *PRACTICAL MECHANICS' Journal*, 1853-4, vi, 107. A portable steam hoisting machine for loading, etc., by A. L. Archambault of Philadelphia is given in *CIVIL ENGINEER Journal*, xii, 373. Chapman's patent portable steam cranes and hoisting engine is described in *BUILDER Journal*, 1860, December 1, Ads., p. iii. BYPOLE; CRANE; DERRICK; GYN; LIFT; SHEERS.

HOISTING BRIDGE. A description of bridge that has been lately employed in canal and railway works where the platform is required to be raised, so as to allow a barge or train to pass underneath, or to shift the load that is run upon the bridge to the upper level. The machinery of these bridges will be described under LIFT. G. R. B.

HOLAHONUKA. A light coloured wood of Canara, East Indies, obtained from 3 to 4 ft. in circumference by 30 ft. long, and used for beams in building. 71.

HOLANDA (FRANCISCO) was born 1517. The MSS. of this 'architecte et enlumineur' were discovered by count Raczyński of Berlin about 1846 (*BUILDER Journal*, iv, 435) in the library of the Jesuits at Lisbon. Amongst them is a dialogue which took place at Rome between him, Buonarroti, Vittoria di Colonna, and others. Another consists of an official report made to king Sebastian, "on the utility of the art of design in a Christian republic, as well in time of peace as in war", in which he recommends that the king should have a knowledge of drawing to enable him to distinguish the character of the persons he has to employ as exhibited in their physiognomy. RACZYŃSKI, *Arts en Portugal*, 8vo., Paris, 1846, calls him a civil and military architect, designer, illuminator, painter and writer, to which BERMUDEZ adds *modeleur en terre*; but there is no evidence of his architectural talent, except that he made drawings or plans of the fortresses of Rome, Naples, Florence, Civita-Castellana, Milan, Ferrara, Nice, Genoa, Serzana, Ancona, Padua, and Pesaro. RACZYŃSKI gives the following extract from one of Holanda's letters: "The fortresses ought to be constructed in bricks and not in stone. The fortress of Mazagaõ, of which the designs and models were ordered of me by the king and the infante, is the first strong place which has been constructed in Africa. It is a pity that it has not been built of bricks according to my directions given to the king; and I made the plan of it after my return from Italy and France, where I have measured with my own hands the principal fortifications of the world." He died 1584 at Lisbon.

HOLBEIN (HANS) was born about 1498 either at Augsburg, at Basle, or as lately considered, at Grünstadt. He learnt painting from his father; and at Basle painted the front of a house in the street Eisengasse with buildings and histories, for which he received sixty florins. From thence in 1526 he went to England, where, three years afterwards, he was taken into the service of king Henry VIII. Besides numerous works in painting which will not be here noticed, he made designs for art manufactures; of these a drawing of a cup for the king (given in GRUNER, *Ornamental Art*, fol., London, 1850, pl. 6); another for a clock and dial; one for a large chimney piece (authenticated in the following quotation, "I have seen many peeces of his in oile, and once of his owne draught with a penne a most curious chimney-peece

K. Henry had bespoke for his new built palace at Bridewell," by PEACHAM, *Compleat Gentleman*, 4to., Lond., 1634, p. 109; and others for jewellery, etc. (given in two plates in SHAW, *Encyc. of Ornament*, 4to., Lond., 1842), deserve special attention, and are all now in the British Museum.

He is also supposed to have designed the following architectural works. Between 1530-6 the gateway at Whitehall (the plan and elevation are given in the *VETUSTA MONUMENTA*, i, 1725, pl. xviii, xviii; WILKINSON, *Lond. Illust.*, 4to., 1819-23, from a print by Silvestre about 1638; and a later and more careful one in the Pepysian library at Cambridge; and in LONDON and its *Environs*, 8vo., 1761, vi, 315): the gateway was taken down August 1759 for the improvement of the neighbourhood; SMITH, *Antiq. of Westm.*, 4to., 1807, 22, gives a design by T. Sandby, R.A. for rebuilding it in Windsor park, where it was taken by the duke of Cumberland, but not being erected, the materials were used up in other works. The ceiling of the chapel in S. James's palace, dated 1540 (given in RICHARDSON, *Arch. Remains of the reigns of Elizabeth and James I.*, fol., Lond., 1838). The first house at Wilton, Wiltshire, about 1540, for Sir W. Herbert, first earl of Pembroke; this was afterwards burnt, and was rebuilt by Jones and Caus; the porch of entrance to the hall, situate in a quadrangle, was preserved till about 1800, when it was removed and erected in the grounds as a gateway (given in HOARE, *Modern Wiltshire*, fol., Lond., 1825, ii, 133).

It has been generally stated that he died 1554 of the plague in London; and Stow, *Survey*, edit. STYVE, fol., 1720, says he was buried in the church of S. Katherine Cree, Leadenhall-street. A will, dated 7 Oct. 1543 and proved in Nov., has been lately found of a "John Holbeine, servant to the kings majesty," it is presumed to be that of this well known artist; *ARCHÆOLOGIA*, 4to., Lond., 1863, xxxix, pp. 1-18, 272-6; *BUILDER Journal*, xix, 132, 145. It is probable that he was succeeded in the king's employment by John of PADUA, whose warrant "pro servitio in architecturâ et musicâ" is dated 1544; WALPOLE, *Anecdotes*.

W. P.

HOLDEN (THOMAS). This name is inscribed on the façade of Ironmongers' hall, Fenchurch-street, London, erected (of Portland stone) in 1748; the dining hall is 70 ft. long, 30 ft. wide, and 30 ft. high. CHAMBERS, *Civil Arch.*, 8vo., London, 1791, s. v. Windows.

HOLDFAST. A sort of wrought iron spike used by carpenters for fixing rough work where the stuff is not framed, and by joiners for securing ordinary shelves, etc., to walls, or other 'hold.' It is made with a shoulder, by which it is driven into the wall with a hammer, and a vertical round flat head in which there is a hole for a clout, or dog nail to secure the wood or other work. Holdfasts are made in lengths varying an inch each, from 3 ins. up to 9 ins., and are sold by weight; the small sort for 4d., and the large for 6d., per lb.

A. A.

An iron hook or washer shaped like the letter S fastened to a wall for its support, was also called a holdfast.

4.

HOLE. The term used for any very small opening in a wall or incision in wood or other work. **APERTURE.**

Where a shutter in a window opening is customarily kept closed, as in a coal cellar, it is common for it to have a number of formally-arranged perforations for light and ventilation. J. W.

A number of small holes or apertures are to be seen in the vaulting of the collegiate church of S. Mary Ottery, Devonshire, several of which terminate with a leaden socket projecting from an inch to an inch and a half into the church. These holes are 100 in number, and others may be obscured by the whitewash; none are to be seen in the lady-chapel. WKB, *Ecclesiology*, 8vo., Lond., 1848, p. 27, says that in 1844 he saw workmen suspended in cars by ropes from holes in the vaulting scraping the whitewash from the stonework of the choir of S. James at Liège. Many of the Belgian churches have them,

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and the effect is strange and displeasing. At Winchester cathedral there are at least 159 in the nave and aisles; at Exeter cathedral 50 remain. It is supposed that they were intended for the purpose of suspending lights on grand displays; MARKLAND in *Transactions of Exeter Architectural Society*, 1853, iv, 60-8.

Some exist in Redcliffe church, Bristol; and probably, more or less, in all medieval vaultings; at Westminster abbey church they are of use in suspending scaffolding. In Italy they are often disposed in regular patterns, and the aperture surrounded by a metal star, which has by no means a bad effect.

HOLL or HOL (ELIAS), one of the chief *baumeisters* of Bavaria, was born 1573 at Augsburg. His father, JOHANN, a master mason much employed by count Fugger of Augsburg, instructed him in the elementary principles of architecture, and being taken to Italy by the merchant Garb, he there studied, especially at Venice, where he resided a long time. Before he left for Italy he built the *Mariahilfs kirche*, on the Lechfeld; the *giesshaus* or foundry; the *bäcker-zunft-haus* (bakers' corporation house), on the Perlachberg; the *zeughaus* or arsenal, on the Moritzplatz; and many other buildings. On his return he designed the *iegelhaus* or seal house; the *schlacht-haus* or abattoir; the two fountain towers of the *Jacobs-thor*; the bridge at the *barfusserthor*; the towers of Wertach, Klinken and *rothethor*; the hospital; the church tower; the new gymnasium of S. Ann, and many others. But his masterpiece is the *rath-haus* or town-hall, built 1615-1620 (1617-9), one of the best, though not the largest, in Europe: it is 147 ft. long, 110 ft. deep, and 152 ft. high in the centre. The *kaisersaal*, or imperial or golden, hall, was painted by Kager and Rothenhammer; the building was engraved by Sol. Kleiner. He also built the castle or palace at Schönfeld; that at Willibadsberg; at Eichstädt, and others. Holl died in 1636 (not 1646 as often stated) at Augsburg, aged 63 years. WAGENSEIL, *E. Holl, baumeister, biogr. skizze*, 8vo., Augsburg, 1818, has not been seen.

14. 34. 68.

HOLL (JOHANN), nephew of ELIAS, is said to have assisted his uncle in all his works constructed in later years.

68.

HOLLAND (HENRY), F.S.A., was born about 1746. He was a relative of L. Brown, landscape gardener, through whose interest, it is supposed, he was employed 1763-4 to design Claremont house, near Esher, Surrey, for Lord Clive (RICHARDSON, *New Vit. Britt.*, fol., London, 1802, i, 61-3): and about the same time to make large alterations and additions to Trentham, Staffordshire, for the duke of Sutherland, such as the dining room and private apartments to the east, and the drawing room to the west (ACKERMANN, *Repository*, 1824, iv, p. 2), these were probably removed by Sir C. Barry's alterations (WATTS, *Seats*, etc., 4to., Chelsea, 1779). In 1771-2 Battersea-bridge, of timber, was built under his directions by — Phillips, carpenter, at a cost of about £20,000: in 1777-8 he designed Brookes's club-house, No. 60 St. James's-street, the front is now partially altered; and about 1780 he rebuilt Wenwoe castle, Glamorganshire, 'in a grand old castle style' (GENTLEMAN'S MAGAZINE, 1785, iv, 937). About 1780 he took one hundred acres of land in Chelsea on a building speculation; laid out Sloane-street, Cadogan-place, and Hans-place, erecting the white brick houses on the west side of the first named; reserving to himself a large plot of ground for a villa in the latter, he sublet the remainder; a plan is in the king's collection at the British Museum; and the particulars of sale of the villa, dated June 1807, is in the library of the Royal Institute of British Architects. About 1786 he designed for the duke of York the vestibule and portico entrance in Whitehall to Featherstonehaugh house (the work of Payne), afterwards called Melbourne, and Dover, house (MALTON, *London*, etc., fol., London, 1792, pl. 26); 1788-90 he altered and enlarged Carlton house, Pall Mall, for George prince of Wales, afterwards George IV (Flitcroft had been engaged there in 1733), forming a grand suite of rooms, renewing the whole of the façade 195 ft. in length

s

with a portico of the Roman Corinthian order to receive carriages under it (when the building was pulled down in 1827, the columns were used after material alterations in the portico of the National Gallery): he also designed the open colonnade in front of the court-yard (views are given in BRITTON and PUGIN, *Edifices*, etc., ii, 193-201; PYNE, *Royal Residences*, 4to., London, 1819, with coloured plates; ACKERMANN, *Repository of Arts*, etc., 8vo., London, 1809, i, 400; 1812, vii, 29; 1822, xiv, 187; and some were reprinted in PAPWORTH, *Select Views*, etc., 8vo., Lond., 1816. STIEGLITZ, *Plans*, etc., fol., Leipzig, 1800, pl. 80, gives a screen 'resembling' that at Carlton house). The stabling and riding-house, after having been used as a record office, were taken down 1858. The Gothic conservatory was built by T. HOPPER. He designed 1791 (opened 12 March 1794) Drury Lane theatre for R. B. Sheridan, at a cost of about £200,000: it was burnt 24 Feb. 1809 (the plan with interior and exterior views are given in WILKINSON, *Londinia Illustrata*, 4to., London, 1819, and a coloured interior view in ACKERMANN, *Microcosm*, 4to., Lond., 1808, i, 228). He altered 1794 (opened 15 Sept.) Covent Garden theatre for Mr. Harris: it was burnt 20 Sept. 1808 (an interior view is given in WILKINSON, and a coloured one in ACKERMANN, where it is stated to have been altered in 1799): DALLAWAY, *Anecdotes*, 8vo., London, 1800, p. 155, remarks that "the houses designed by him fronting the Green-park have ornaments of too florid a style for street architecture," but does not particularise the houses, which are probably those adjoining Hamilton-place, Piccadilly. In 1795 he designed Southill house, Bedfordshire, for S. Whitbread, esq. (given in NEALE, *Seats*, 4to., London, 1829, ser. 2, v; and ACKERMANN, *Repository*, 1825, vi, 63); and 1799-1800 the façade, 190 ft. in length, in competition, for the new building of the East India house, Leadenhall-street, R. Jupp being then surveyor to the company (given in BRITTON and PUGIN, *Edifices of London*, 8vo., London, 1828, ii, 78-89; the building was sold July 1861, and pulled down in the following year).

About 1800 he designed the pavilion at Brighton, subsequently remodelled and altered by J. Nash and W. Porden (given in RICHARDSON, *New Vit. Brit.*, fol., London, 1802, pl. 7-8): for earl Spencer, some works at Althorpe, Northamptonshire; and completely rebuilt 1801 the mansion (on a new site) at Wimbledon-park, Surrey; the grounds were laid out by L. Browne (a view is given in ACKERMANN, *Repository*, 1825, v, 64): made improvements at Woburn abbey, Bedfordshire (built 1747 by H. Flitcroft), for the duke of Bedford, comprising 1789 the conservatory (cir. 1820 formed into the sculpture gallery by Sir J. Wyattville), 138 ft. long, 25 ft. wide, and 22 ft. high; with the temple to Liberty at its eastern end, an adaptation of the ancient example of the temple on the Ilissus; modelled the Canaletti room; and the library; and designed the entrance to the park from London, the Chinese dairy, with the tennis court and riding house (ROBINSON, *Vitruvius Britannicus* (Woburn Abbey), fol., London, 1827, pp. 12, 15-6): and works at Little Willenham, Staffordshire. The Albany chambers, Piccadilly, established 1804 behind the house erected (before 1770) by Sir W. Chambers, was another of his building schemes. His last design probably, was the colonnade screen wings, and pavilions to the assembly rooms (built by R. Adams) now the athenæum, at Glasgow, this work being finished in 1807. Oatlands park, Surrey, for the duke of York, rebuilt after the fire of 6 June 1794, is attributed to Holland, but BRAYLEY, *Surrey*, 4to., Dorking, 1841, ii, 387, states it to have been designed by John Carter in a castellated style: as is also the house of Sir W. W. Wynn in S. James's-square, but this was designed by R. Adam in 1773. He died in Hans-place 17 June 1806, aged about 60 years, leaving two sons named Henry and Lancelot, and three daughters. A marble bust of him by Garrard is placed opposite the entrance to the sculpture gallery at Woburn abbey.

In 1774 Holland was residing in Halfmoon-street, Piccadilly, and was then district surveyor of Hatton-garden Liberty, Ely

Rents, Saffron-hill, S. Mary-le-Strand with the Duchy of Lancaster and Precincts of the Savoy; he succeeded Jupp about 1799, as architect and surveyor to the East India Company, being succeeded by S. P. Cockerell (*GENTLEMAN'S MAGAZINE*, 1806); he was in the commission of peace for the county of Middlesex. His pupils were J. Crunden, and, it is said, Sir J. Soane (pupil of G. Dance) before the latter gained the gold medal of the academy in 1776. He is also presumed to be named in the firm of Holland, Copland, and Rowles, timber merchants, 1795, 1801, etc.: his professional office was broken up in 1807, nine months after his death, his nephew Henry Rowles, acting for him at that time, and to whom he left his architectural books, drawings, and casts.

He acted as 'reporter', and published *Resolution of the Associated Architects, with the Report of a Committee appointed to consider the causes of the frequent fires, and the best means of preventing the like*, 8vo., London, 1793; contributed a paper *On Cottages* to the BOARD OF AGRICULTURE, *Communications*, 4to., London, 1797, i, pt. ii, p. 97; and i, pt. iv, 387, etc.; *Pisé, or the art of building strong and durable walls to the height of several stories, with nothing but earth or the most common materials*, a translation of the work by COINTERAUX, *Traité sur la construction des manufactures et des maisons de Campagne*, 12mo., Paris, 1791, wherein it is stated to be a practice in the province of Lyons for ages. PAPWORTH, *Rural Residences*, 8vo., London, 1818, p. 15, notices this construction as "introduced into England by the late Mr. H." He is better known as the developer of the Anglo-Greco-Roman style, the ornamental decorations being somewhat after those of the Adams': and for introducing about 1782 the art of GRAINING and marbling from Paris in the works at Carlton house. He does not appear to have exhibited at the Royal Academy. *BUILDER Journal*, xiii, 423, 437; PENNY CYCLOPÆDIA, Supp., 1846.

SOANE, *Letter to Earl Spencer*, 8vo., London, 1799, p. 5, states that Holland (as a witness) deposed that "he was in the habit of charging one, two, and two and a half per cent. in addition to the usual allowance of five per cent." for measuring up works, which was combated by Soane; the verdict was given against the claim made by — Stoddart, and in favour of the county of Northampton, the defendants.

W. P.

HOLLAND (RICHARD), perhaps a brother of the above Henry (or "my cousin, of Madley, Herefordshire", one of the executors), exhibited designs at the Royal Academy of Arts, in 1771 and 1773. He designed Debden hall, Essex, for R. M. T. Chiswell, esq.; a view of the south front is given in WRIGHT, *Essex*, 4to., London, 1835, ii, 139; and in NEALE, *Seats*, etc., 4to., London, 1818, i, wherein it is dated 1795: he also designed the font (in Coade's artificial stone) in Debden church, 1786, and perhaps superintended the restorations of that structure about the same period. In 1792-3 he lent Nos. 5 and 10 Hans-place to the committee of Associated Architects, for the purpose of trying the inventions of Lord Stanhope, Hartley, and Wood, against the spreading of fire, as detailed in the work mentioned in the preceding article.

W. P.

HOLLINGTON STONE. A sandstone raised at Hollington, near Rochester, near Ashborne in Staffordshire. It is one of the members of the carboniferous series, and consists of silicious sand united with silicious cement, deposited in layers and planes of stratification distinctly marked; with plates of mica interspersed, generally occurring upon the planes of division. The stone has been largely used in the locality, as at Trentham hall; Drayton manor; the town halls of Derby, Macclesfield, Stoke upon Trent, Newcastle, etc.; in many buildings at Birmingham, Burton, Crewe, Heywood, Leek, Leicester, Manchester, Nottingham, Warwick, and their neighbourhoods; and in all the churches in the Staffordshire Potteries; but the expense of carriage, and the cost of labour upon it, have effectually opposed its introduction into London up to the present time. It can be raised in blocks of

about 5 ft. in thickness and from 18 to 20 ft. long, if required. Extreme care is necessary to observe the bedding, as the stone is very liable to flake off in the direction of the beds; Hollington stone is, in fact, subject to all the inconveniences attending the use of Yorkshire stone, of which it is precisely an analogous deposit. It is now (1864) being introduced into the London market to take the place of Portland stone when a difficulty arises in obtaining that material; and it is said to stand the London atmosphere well, and wherever tried to have given complete satisfaction.

G. R. B.

HOLLIS (CHARLES) designed 29 March 1821—3 July 1823 the church of All Saints, Poplar (Grecian), at a cost of £18,000, and with the parsonage house, etc., £33,077 (given in BRITTON and PUGIN, *Public Buildings*, etc., 8vo., London, 1828, ii, 202); designed 15 Sept. 1820-2 Windsor church, but superintended by J. Wyatt, the contract was for £9,000, but it ultimately cost £14,000; and 10 July 1822-4 Windsor bridge, consisting of three arches of iron, 200 ft. long and 26 ft. wide; the centre arch is 55 ft. span.

HOLLOW. A sunk molding used in mediæval architecture to connect projecting work. It is in section an egg-shaped oval, with about one-third of the long side cut off. The term is also given to a concave molding in shape about a quadrant of a circle; also called CASEMATE or CASMENT; and ABACUS. Moxon, *Vignola*, 12mo., London, 5 edit., 1729, p. 34, uses the term "flute or hollow" of a triglyph. CAVETTO. 2. 4.

HOLLOW BRICK. A brick formed by hand or by machinery with one or more perforations or spaces in the body of it, to ensure either a more perfect soundness whilst in burning, or to render it lighter than an ordinary brick of the usual solid character. In 1853 Norton and Borie's patent hollow bricks were considered by the Official Referees under the Metropolitan Building Act to be 'sound bricks,' "each header having six transverse, and each stretcher three longitudinal, perforations;" *BUILDER Journal*, xi, 491. An objection to the use of perforated bricks is that, from the difficulty of their manufacture, they are so much dearer than good sound stocks.

J. D. Antoine has the credit of designing the three ranges of arcades in hollow bricks, for archives, between the ceiling and the roof of the *salle des pas perdus* at the palais de justice at Paris, and executed about 1778. Such bricks are also named to be used in vaulting the basement of a dwelling, '*brignes pleines ou creuses*,' in MANDAR, *Etudes d'Arch.*, fol., Paris, 1826, p. 8; and in 1822 the palace of Prince Albrecht at Berlin was built of these materials.

Benford Denton patented 1812 peculiarly formed tubular bricks for conveying air: this invention was lost until it appeared in France as a novelty, and so called by PACKH, *New mode of Constructions with hollow bricks*, Pesth, 1831, who states that they were made for a number of years, and employed in the construction of the harbour at Toulon, where they were seen by prince Metternich in 1825, who sent specimens to the Vienna Institute. PACKH tested one brick, having two circular perforations in its length, by placing on it 1900 common bricks, forming a cube of 7 ft. weighing 160 Viennese cwts., without its being affected until subjected to motion: 250 cwts. were placed upon another brick, which stood the test for six months; he then built a gardener's house at Kirchenberg, as well as a vault to carry a large water reservoir in the same locality. Lieut.-Col. Fischer of Schaffhausen patented perforated bricks of several forms. In 1841 Thunderer and Stellewerk of Vienna patented improvements in the construction of vaultings, which consisted of hollow bricks made to slip one into the other and so bond together. BROGNART, *Traité des arts céramiques*, etc., 8vo., Paris, 1844, i, 577 (2 edit., 1854), describes a kind of hollow brick by Boch-Buschmann, a Prussian engineer. In France in 1842 Collas of Paris patented the manufacture of solid and hollow cylinders, moldings, etc., for filling in between girders, for partition walls, etc.; but the invention was not carried into practice. In England, in 1845, Beart patented

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the manufacture of perforated bricks by the expression of brick earth through die plates provided with cores to form the perforations: these bricks were not only of the common form, but also for copings, door and window moldings in great variety. In 1846 three other inventions were patented; 1. by Franklin; 2. by Ransome and Warren; and 3. by Percy. A later one was Bale's glazed hollow bricks; with many others offering various advantages. In 1848 Messrs. Borie patented and set up a factory for hollow bricks in Paris, their machine being a palpable copy of Beart's, the claim of originality was abandoned in a certain lawsuit, and confined to the goods. In the Exhibitions of 1851 and 1855 they obtained medals, and proceeded for an infringement of their patent against Chaudet, jun.; then against Chevalier and Cie.; and against Mortier, Courtois and Cie., whose tiles have been introduced by Capt. Powke in the roofing of the Sheepshanks gallery at Kensington; they purchased Clayton's hollow brick machines in the French Exhibition of 1855; and the proceedings were again decided in favour of Messrs. Borie.

In 1850 the *BUILDER Journal*, viii, 152, noticed a hollow brick or tile, 3 ins. square, 12 ins. long, and five-eighths of an inch in substance as useful for partitions; and p. 53 illustrated a form for a ventilating brick by R. Rawlinson (9 to 12 ins. square, 1 to 3 ft. long and $\frac{1}{2}$ to $\frac{3}{4}$ in. in substance), when printing ROBERTS, *Dwellings of the Labouring Classes*, paper read at the Royal Institute of British Architects, who used the patent bonded hollow bricks or rebated tiles of Hertslet and Co., in the model lodging house in George-street, S. Giles's (also shewn in *CIVIL ENGINEER Journal*, xiii, 127). In 1852 the *PRACTICAL MECHANICS' Journal* noticed the peculiar shaped brick for forming two hollow spaces in a wall and for binding themselves together. About 1855 Chevalier, Bouju and Cie. of Paris introduced perforated bricks of much larger size, lighter, stronger, and cheaper, than those of Borie's, and which were much used (1857) in floors: for which purpose hollow blocks of plaster have sometimes been employed.

The *Transactions*, ix, of the Imperial and Royal Polytechnic Institute of Vienna contains an article on the manufacture of hollow bricks and the machines; the *HANDLUNGS ZEITUNG* for 1827 an account of the use of hollow bricks in Russia; PACKH's account in 1831 has been already noticed; *ALLGEMEINE BAUZEITUNG*, 4to. and fol., Vienna, 1863, p. 252, gives *der hohlen ziegel bei bauten in Paris*, a description of the bricks made by Borie; and *BUILDER Journal*, 1849, vii, 152, 182, 186, 199, the description of those used in the vaulting over S. George's hall, Liverpool, by RAWLINSON, portions of which had been read at the Royal Institute of British Architects. *Murs creux en plâtre et plâtras; Murs en briques tubulaires; and Murs creux*, are noticed in DALY, *Revue Générale*, 1849, viii, 203, 397, pl. 43. *Fabrication des briques creuses; mémoires pour MM. Chevalier, Bouju & Cie., défenseurs, contre MM. Borie & Cie., plaignants*, Paris, Renou et Maulde; which work was reviewed in the *BUILDING NEWS Journal* (iii, 251); 1858, iv, pp. 317-8, 383, and giving numerous cuts of the shapes of the bricks and forms of the perforations in them.

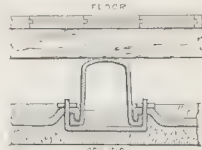
The term 'hollow or hollowed brick' is applied to a brick sometimes employed in drains and watercourses, having a concavity formed on one side of it.

Hollow bricks and tubes, and hollow brickwork have been introduced by many parties as methods of obtaining warmth by warm air channels; and also for ventilation by means of the same or similar channels formed in the bricks themselves. Beedle and Rogers' ventilating bricks are 9 ins. square and 3 ins. thick, with a half circle taken out of each end to admit of currents of air through the space; *BUILDER Journal*, 1849, vii, 359; and *PRACTICAL MECHANICS' Journal*, ii, 142. HEAT; and BATHS, etc., in *Detached Essays*.

The system of construction with earthen tubes will be considered s. v. POT CONSTRUCTION.

HOLLOW GIRDER. A wrought iron girder, invented by

Zorés of Paris. It is similar in form to a cross section taken through the centre of an inverted garden pot; it is $4\frac{3}{4}$ ins. high, $2\frac{3}{4}$ ins. wide at top, 4 ins. wide at bottom where the opening is placed, the thickness of metal being $\frac{1}{8}$ of an inch at the sides, and $\frac{7}{16}$ of an inch at the top, with turned-up edges or flanges. These girders 2 ft. 8 ins. apart, are supported in the walls, and tied together at distances of 3 ft. by flat ties; the openings are downwards. The edges are turned back and riveted to the tierods. Between each pair of hollow girders an arch of hollow bricks is built, which stays and stiffens the girders. The wooden joists carrying the flooring rest upon the girders and upon the crown of the arch. Another form of hollow girder has a double head, as it were, forming a groove, whence its name *fer à coulisse*. The dimensions are $5\frac{1}{2}$ ins. deep, the top and bottom flanges 1 in. wide; the intermediate flange, which is within $\frac{1}{8}$ of an in. of the top one, is wider than the rest $\frac{1}{8}$ ins.; the thickness of metal is $\frac{1}{8}$ of an in.; the weight is 3.6 lbs. to the foot run. When this girder is used, small wooden joists are not required, but the flooring is laid at once; for this purpose the end of each of the oak battens, of which the *parquet* or flooring is composed, is grooved or ploughed tolerably deep, to receive the top flange of the girder; this arrangement presents several advantages; BUILDING NEWS Journal, 1857, iii, 251. The "systèmes Zorés" is illustrated in DALY, *Revue Générale*, 1853, p. 133, pl. xi.



GUETTIER, C.E., *Strength of cast iron beams and girders*, an analysis of which was read by Tronquoy at the Institution of Civil Engineers before May 1856. The author stated his belief that hollow girders were much stronger than solid ones, but in casting them, the difficulty of keeping the core in the centre so as to obtain an equal thickness of metal on all sides, was a great obstacle to their employment; BUILDING NEWS Journal, 1856, ii, 249. GIRDER; FAIRBAIRN'S GIRDER.

W. Hood of Reading, designed a 'patent improved hollow beam or girder', to hold water to prevent its becoming heated in large fires, described in BUILDING Journal, 31 Aug. 1861 (cut in advertisements); and 1862, xx, 212, from the ENGINEER Journal; the bottom of the beam being pierced, the water would flow out and assist in extinguishing the fire. The objections to such a system have been noticed by LEWIS, *Fireproof Constructions*, in *Transactions of Royal Institute of British Architects*, 1864-5, p. 116.

HOLLOW NEWEL. A name often given, as well as 'open newel', to an open well-hole staircase, and which when on a large scale is generally called a GEOMETRICAL STAIRCASE. There are several in Rome, particularly one at the Cenci palace, where the inner end of the steps is supported on a wall forming a sort of internal cylinder, with openings in it to look down below, so that no hand-rail is necessary. One of a square form is shewn in PALLADIO's work on architecture. A very curious staircase of this sort was at a house at Wimbledon designed by H. Holland for one of the late lord Spencers; the grand staircase wound round the outside of a large hollow cylinder, inside of which was the servants' staircase; the latter obtaining light by openings in the cylinder, and having doors of access on each landing. The same form is to be seen in Roehampton house, late the earl of Besborough's, now the college of Jesuits. A similar staircase, only of a square form, was executed at Ambresbury in Wiltshire, by J. Webb from a design by Inigo Jones. The staircase in the palace at Chambord has a hollow newel from the ground to the roof, above which the staircase rises. A small circular staircase may have an open newel, and is then often called a 'spiral staircase', as seen in many old German buildings. A. A.

HOLLOW QUOIN. The recess made in the walls at each

end of a canal lock for receiving the gates, and properly hollowed out to fit the shape of the quoin posts.

HOLLOW TILE, see BORIE's cellular roofing tile; and Hollow Brick.

HOLLOW WALL. At various times and for various reasons walls have been built hollow, either by a disposition of stone or of ordinary bricks, to allow of a cavity being left in the interior of the wall, or by using hollow bricks; and sometimes that it has been desired to lessen the weight of the wall without diminishing its thickness. In the middle ages walls were built with passages in their thickness, to give a larger base to resist outward thrust.

As air is not so good a conductor of heat as stone or brick, rooms enclosed by hollow walls are (*ceteris paribus*) of a more equable temperature than those bounded by walls built solid. It is a point in dispute whether the vacuity in the wall should communicate with the external air (BUILDING Journal, xviii, 64), it being affirmed that when this is the case, in very sudden and extreme changes of temperature, condensation on the inside frequently takes place, which would spoil a delicate paper. In exposed situations it is necessary to guard against the penetration of damp through walls, by more than ordinary precautions; and hollow walls have been used with varying success. The advantages of the system may be enumerated as follows.

1. They are equally strong, if not stronger, than solid walls.
2. Saving of material, and therefore lighter.
3. Drier, by preventing damp penetrating.
4. Bad conductors of heat, rendering the building warmer in winter and cooler in summer.
5. Security from extension of fire, battened walls, as in the common method, not being used.
6. Accommodation for boxings of sliding shutters, etc.

In executing such construction in brickwork, the points to be kept in view are the following.

1. Efficient bond of the inner and outer faces.
2. No through joints, or as few as possible.
3. Half bricks avoided; every header being a whole brick.
4. Simplicity of arrangement.
5. The appearance externally of English or Flemish bond; or some other effect equally good.
6. Economy.

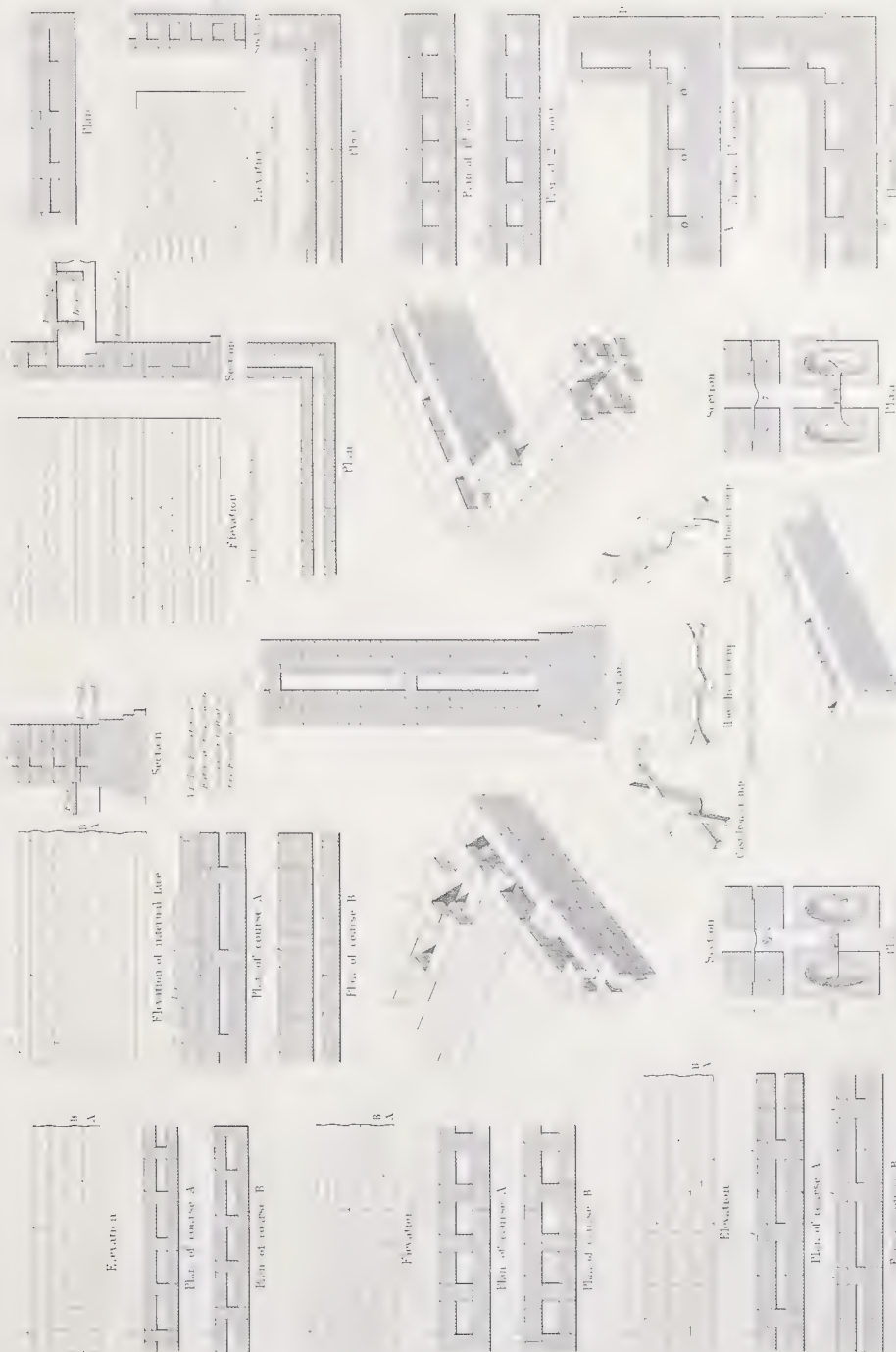
It is in the southern and south-eastern counties of England that hollow walls are most frequently built. They are designed in every variety of manner, but the principal and most efficient appear to be as follows.

| | | | Cavity. | Bond. |
|----|--|---|---------|----------------------|
| 1. | The bricks laid on edge | - | - | 3 in. Brick. |
| 2. | flat, two half bricks | - | - | 4½ in. Do. |
| 3. | do. do. | - | - | 2½ in. Do. |
| 4. | do., a 9 in. wall with half brick lining | - | - | do. Do. |
| 5. | do., various, two half bricks chiefly | - | - | do. Wt. iron crps. |
| 6. | do. do. do. | - | - | do. Cast. iron crps. |

1. An economical method for hollow walls, and one executed frequently in the southern counties of England, is that of building two half brick walls in Flemish bond with brick on edge, leaving a cavity of 3 ins. This is of course only available for small buildings, such as cottages, and the chief objection to it is its unsightliness; but it has many advantages, not the least of which is the uniformity of thickness, 9 ins., and simplicity of construction, as figs. 1, 2, and 3, *Illustrations*, s. v., 1863-5. Air bricks should be inserted in the external walls, both above the ground line and under the eaves, in this and in the following modes.

2. The most simple in arrangement of all hollow walls, where the bricks are laid flat, is that formed by two half brick walls with a 4½ in. cavity, the bond being made by the bricks themselves. The first course on (say) the inside consists of alternate stretchers and headers, the outside all stretchers, as figs. 4 and 5. The second course (being the reverse) has all stretchers on the outside, with headers and stretchers alternately on the inside, as figs. 4 and 6. An objection to this arrangement is that it is not economical, the bond being more

HOLLOW WALL.





frequent than necessary; and also that the cavity consists of a series of flues having no lateral communication. Fig. 7 shows an arrangement for obtaining a 6 in. cavity, with good bond; but no additional advantage is apparent beyond that of obtaining some greater degree of strength in consequence of a wider base.

3. A mode of bond for two half brick walls, not open to these objections, but having a 2½ in. cavity, is the following arrangement. Each course is laid with two stretchers to one header, both on the inside and outside, as figs. 8, 9, and 10; the header or bonding brick of the alternate courses being placed horizontally midway between those above and below. A dubbing out bat is necessary at c, figs. 9 and 10, on the inside face of the wall, unless bonding bricks made 11½ ins. in length are used: bricks called "safety bricks for building hollow walls of 9 in. thickness and upwards" were invented and manufactured by J. W. Hiort about 1833. Fig. 11 is a perspective view of a similar arrangement, with three stretchers between each header.

4. A more efficient wall may be formed by making either the inside or outside work 9 ins. thick. In the latter case, the appearance of old English bond may be obtained (on the outside face) by the arrangements shewn in figs. 12 to 16.

Although manifestly the thicker wall should be on the outside, since it allows less damp to find its way into the cavity, and which the warmth of the dwelling would the sooner evaporate, still instances are to be found, as in Sussex and elsewhere, where the thinner work is placed outside.

5. Instead of using the bricks themselves as a means of bond, *iron cramps* are very frequently employed. In the Isle of Wight, wrought iron rods have been used for the last twenty years, of ½ in. diameter, bent to a form to assist their rigidity when in position, as figs. 17 and 18. Another and better form of wrought iron cramp in use in Hampshire, is ¾ × ¼ and 7 ins. long, shaped as in figs. 19 and 20. The precaution of tarring and sanding these cramps is sometimes adopted; and they are built in at about 2 ft. 3 ins. apart, at every fourth course in height. The appearance of old English or Flemish bond is carried out on the outside face of the wall, but of course the headers can only be half bricks. The three figs. 21, represent the forms of iron cramps at present in use at Southampton; the cast iron cramp being considered the most lasting. Hollow brick walls are sometimes used for granaries; but they are objected to for harbouring vermin, and weather boarding is generally preferred.

J. J. T.

The following notes of opinions on this mode of construction, may prove of interest to those who may be contemplating the use of hollow walls.

Hollow walls are said to have this inconvenience, in common with all walls which are not built solid, if there be any flaw, as a fire crack in any external brick, or a defective mortar joint, the driving rains get into the hollows and run down from top to bottom, keeping the walls damp, and often coming through on the inside. Where openings occur in a wall of this character, a correspondent notices that the head should be protected through the whole thickness of a 9 in. wall, by a piece of lead turned up on the inside and downwards on the outside, to carry off any water which may enter into the space, and which would otherwise soak into the plates. He also states that he always places ventilators at the top and bottom of the wall to afford a current of air.

At Southampton, the hollow wall system prevails to such an extent that at least 80 per cent. of the dwellings of the working classes erected there (1851-61) are so built. The method adopted is this: two 4½ in. walls with a space of 2 ins. are built, and connected by means of light iron clamps, shaped somewhat like the letter H, the two parallel bars being about 3 ins. by 1 in. by ¼ in., and the connecting bar from ¾ in. to 1 in. diameter, and of such length as to allow the parallel bars to rest in the frog of the brick: a boss or molding cast on the connecting bar in the centre of its length prevents the passage of moisture

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along the clamps. These clamps are usually built in every fourth course in height, and about 3 ft. apart in the length of the wall: care being taken to place them in each alternate tier in such a manner that they shall 'break joint' with each other. These clamps are sold by every local ironmonger. No wall splitting or failure has occurred. Where headers have been placed through the whole thickness of the wall, they have never failed to be detected by a damp spot on the internal plastering, or by a soil on the paper, in damp weather. Another very common local custom to keep thin walls dry, is to cover them with slating like a curb roof; *BUILDER Journal*, xx, p. 283. This is also a common practice in Devonshire.

"The walls—of brick, 11 ins. wide, having a vacuity in the centre of 2 ins., obtained by keeping the width at 11 ins., working the outside fair (even), and on the inside keeping the headers 2 ins. within the line of the stretchers, and keeping these stretchers 2 ins. apart along the centre of the wall, fig. 22. Walls built in this way are at least equally strong with solid walls; always dry, and less easily penetrated by the cold in winter or the heat in summer.—Hollow cottage walls may also be built by placing the bricks, both headers and stretchers, on edge, as first practised by Silverlock of Chichester. They may also be built with bricks halved lengthways by cutting with a knife or wire before burning, as recommended by DEARN, *Hints on an Improved Method of Building*, etc., 8vo., London, 1821, whose methods, at that early period, of forming a 9 and a 14 in. hollow wall, are copied in *London, Cottage, etc., Arch.*, 8vo., London, 1842 (p. 14), p. 168-72: DEARN's diagrams are given figs. 23 to 28. It is not generally known that he sent a communication on this subject to the *REPERTORY OF ARTS* early in 1814, with the figs. 23 to 25.

DEARN, in his work above cited, states that there is "a saving of one-third in the number of bricks, and one-half of the mortar; the labour per rod will be the same: and if the headers are rubbed to a length on both sides, a coat of lime-white inside will be a good substitute for a coat of rendering." The expense of one square of carcase framing 4 ins. by 3 ins., with lath and plaster on two sides, and white one side, is calculated by him at £5:18:2; and one square of walling on this system at £3:9:1½.

"Some houses about to be erected in a situation much exposed to south-west storms from the sea, and the bricks being excessively porous, the walls were built of a half brick outer wall, a 2 in. hollow, and a 9 in. inner wall, the two tied together with wrought iron cramps. At the line of the cills of the chamber windows two thorough courses were improperly introduced. When the houses were completed, the plastering at first shewed a band of damp at the cills, and as the wet weather advanced, the whole of the south-west walls became literally drenched with wet from the line of the cills to the ground floor, which spread even half way across the floors. After examination, the thorough courses were cut out, and frequent openings made in the outer walls at the bottom for the thickness of a joint; these measures have prevented the wet penetrating the inner walls in the slightest degree"; *BUILDER Journal*, 1860, xviii, 78. Another writer, p. 142, observes that two 4½ in. walls, with a space of 3 ins. between them, bonded together with 12 in. headings at convenient distances to make the work secure, with small air grates at the bottom and at the top of the wall to afford a current of air, answered very well even in the case of a house built by the side of a brook, which previously had always been very damp. It was recommended that thorough courses should not be put under the window cills, as the damp would find its way through them, especially if the cills were not properly throated. In xx, p. 250, it is stated that a 10 in. wall, having only a space of 1 in., is considered bad, as all the headers (Flemish bond) going through, would leave a space but 4½ ins. by 1 in., and they would also be more or less choked with mortar. If every third header be carried through, the work becomes scarcely substantial enough: and in p. 268, it is stated

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that a 9 in. hollow wall may be built of bricks on edge, Flemish bond, with a 3 in. space; that it is often so built in the country, but that it does not look well.

"The cellular or hollow wall—for a garden—may be built, if the height does not exceed 10 or 12 ft., with bricks on edge, each course consisting of an alternate series of two bricks set edgewise, and one set across, forming a thickness of 9 ins. with a cill of 9 ins. long by 3 ins. wide. The second course will break joint with it (fig. 1-3). The advantages of this wall are obviously considerable in the saving of material, and in the simple and efficacious mode of *heating*; but the bricks and mortar must be of the best quality. This wall has been tried in several places near Chichester, and at Twickenham by F. G. Carmichael: it is found to succeed perfectly as a hot wall; and if only 10 ft. high to be sufficiently strong for a garden wall, with a saving of one brick in three: on the whole it is stronger than a solid 9 in. wall, on the same principle that a hollow tube is less flexible than a solid one. Cellular walls of greater height might be formed by increasing the width; and piers may be formed on one or both sides of them; as shewn in Loudon, *Encyc. of Gardening*, 8vo., London, 1850, p. 580.

PASLEY, *Outline of a Course*, etc., 4to., Chatham (lith.), 1826, p. 252-4, noticed that "hollow brick walls are sometimes adopted as a security against damp. Nicholson of Rochester has adopted this expedient in those two external walls of his house in S. Margaret's which were most exposed to rain. These walls are each one brick thick, divided by a space of 4 ins., and connected together chiefly by the sills, jambs, and soffits of doors and windows, with in other parts heading bricks occasionally thrown across (fig. 29). The same system has been adopted in several of the Ordnance buildings erected in the Portsmouth district, and along the coast from thence to the eastward. The system is recommended by DEARN (as figs. 23, 24, and 25): and he states his conviction that 9 in. walls of this description are strong enough for the external walls of second-rate or third-rate country houses, two stories high. In such cottages nothing further is necessary than to whitewash the walls inside, which may also be done outside if thought proper; several examples may be seen in Milkhouse-street, Cranbrook, Kent; the walls remain dry inside without being battened and plastered in the usual manner for thin walls. This principle applied at the Ordnance barracks at Shorncliffe, originally built for the horse artillery, was not entirely satisfactory, as the wet penetrated across the vacant space by means of the connecting headers, which occasioned much trouble: in fact, upon that coast, the damp penetrates at times through walls facing the sea, in a manner quite unparalleled in less exposed situations. Upon the whole, it appears to be scarcely worth while to construct the external walls of any building of importance in the manner alluded to, even if the fact last stated did not tend to throw a doubt upon the efficacy of the principle itself."

This system of building appears to have been greatly advocated of late years by American professional men, as is shewn by the following abridged extracts. "By far the best mode of building brick houses is that of constructing them with hollow walls. The advantages are, 1, a considerable saving in bricks and mortar; 2, the prevention of dampness striking through the wall; 3, the saving of lathing and studding on the inner face to prevent the damp showing itself; and 4, the great security against fire: four-fifths of the houses being still built with hollow wooden partitions and walls with inside firing.—Hollow walls have long been the favourite mode of construction in various parts of Europe, and in some places in this country. So far as we can learn, they were first introduced by the late Ithiel Town, architect, and nearly all the best villas at New Haven, where he resided, are built in this mode. A wall built in this way, English bond, as A and B, figs. 30 and 31, is the best and strongest, when the outside is to be stuccoed or cemented. When it is to be left smooth, or to be colored or painted, the bond shewn at C and D is preferable, because

regular courses of stretchers only are presented on the outside. The strength of a wall is greatly increased by placing the bonding bricks, O O, opposite the *side* of a brick, and not opposite a joint. A wall of 16 ins. thickness is amply sufficient for almost all country houses. (The consideration of the want of bond with the interior work, at C and D, appears to have been neglected; and the walls at A and B being in blocks, would appear to be a mistake of the engraver of the illustrations in the original work.) The arrangement shewn in figs. 32 and 33 answers very well for low additions or walls intended to bear but very little weight. The courses would alternate, the heading bricks being kept one over the other. Villas should never have less than 12 in. walls, and 16 ins. is the better mode of building them. The superior excellence and economy of hollow walls must bring this mode of construction into general favour in all parts of the country where bricks are abundant"; DOWNING, *Country Houses*, 8vo., New York, 1850, pp. 58-63.

VAUX, *Villas and Cottages*, 8vo., New York, 1857, p. 64-5, further notices that "hollow brick walls have many advantages—they leave a good place for boxing or sliding shutters";—and then continues, "a course of slate laid in cement should be built in thoroughly the whole thickness of the wall in the line of the basecourse, to prevent capillary attraction taking place between the foundation wall and the inner thickness of 4 in. brick, on which it is proposed on each floor to plaster without lathing. The bond between the outer and inner wall should be of strips of iron, painted or tarred; for if brick bond be used, there will be a slight connection at intervals between the two walls, and in driving storms some damp may possibly get through. The two thicknesses of brick must be entirely and totally distinct if a satisfactory result is to be arrived at. In this trying climate one thing, also, must be borne in mind, that brick is a readier conductor of heat than wood, and consequently that a brick inner wall will absorb more of the heat of a room than a wall that is furled off. It will, however, retain the heat longer, and thus, when the house is once thoroughly warmed, it will appear to be the warmer mode of construction of the two. The fact, however, that the brick wall is so good a conductor of heat may operate prejudicially if the house be shut up and unwarmed for a lengthened period, because the moisture in the air being warmer than the wall will be apt to condense on its surface like frost on a window-pane, and the wall may possibly give signs of dampness, and even injure a delicate paper, when it is in reality impervious to moisture as the frosted glass already referred to. This is an objection to hollow walls that it does not seem possible to overcome, and which has to be considered before deciding on their adoption in a house."

An article in the *American Architects' and Mechanics' Journal*, given in the *Building News Journal*, 1860, vi, 753, states that "a hollow wall is far stronger than a solid one, if judiciously planned and properly constructed, but in these particulars there are certain rules and limits into which it will be as well to inquire.—For instance, it would not be prudent to build a hollow wall for any very responsible purposes with materials whose aggregate (horizontal) sectional area does not equal the breadth of one brick and a half, or 14 ins.; but in the case of a brick and a half wall the outer portion of the work could be built as a single brick wall with its proper bond, and the inner portion would be half a brick thick with the like space intervening; and with a sufficient number of cross partitions, and being banded across, there would be frequent facilities of alternating the bond of the work between the outer and inner surfaces of the walls.—As a general rule the interstice should never exceed one-fourth of the area covered by the points of support, and in no case should exceed 8 or 9 ins., as a comparative weakness would be the result. The length and height of the cells must be regulated by the substance or scale of the wall; for light work they may be made 3 ft. long and 2 ft. high with partitions half a brick thick, and the horizontal

banding courses may be of two courses or 6 ins. high. For walls of more extent the cells may be 4 or 5 ft. long and 3 ft. high. The cells should not be formed below the level of the lowest floor, and there should be 12 ins. or more of solid work above the footing courses before the cells are commenced; and a like mass of solid materials beneath the underside of each floor: and that wherever beams, bearers, girders, etc., bear upon the work, solid piers must be constructed to receive them, lest any vibratory action disturb the work." The walls being comparatively non-conductors of temperature are then noticed; as well as that "the chief and perhaps the only disadvantages of double walls, is to be found in the extra space which they occupy, and which may be considered of importance in town sites, where land is limited and dear; and also in the additional surface of roof necessary,—but upon duly weighing the merits and demerits of *solid* and *hollow* walls, the palm will unhesitatingly be awarded to the latter."

HITCH, *Patent Method of Constructing Buildings and Walls*, 8vo., London, 1828, describes his 'patent rebated bricks' for building the walls hollow, the space being afterwards filled up with concrete; as noticed by GODWIN, *Hints on Construction*, in LONDON, *Arch. Mag.*, 8vo., Lond., 1838, v, p. 577. Facing blocks of an L shape have been made by TAYLOR, *Sundry Sanitary Building Appliances*, in *Transactions of the Royal Institute of British Architects*, 12 January 1863, bonding in with common bricks to form a hollow wall; headers are unnecessary; houses, it is stated, three stories in height have been built with them and a brick behind, producing a dry and stiff wall. JAMES, *Notes on Cottage Building*, read before the Northampton Architectural Society, and given in ARCHITECTURAL SOCIETIES, *Reports and Papers*, 1861, p. 67, illustrates the system of hollow walls.

This mode of construction is even of more importance in stone walls, inasmuch as the latter material is often, and perhaps usually, more porous than bricks. In Kent and Sussex, a builder would be a rash man to erect a house without heeding this important precaution. "In a wing which was built at Pavilion (near Darnick, N.B.) in 1811 for lord Somerville, we built the walls hollow within. The whole thickness was 22 ins.; 10 ins. on each side, with an open space in the heart of 2 ins. They had a range of bonds laid between the outer and inner part in every course of 2 ft., which was the height of the boxes used, and the bonds were about the same distance apart. The walls were mostly two stories high, and were all built of common whinstone rubble; they are standing as straight as when they were built, but as they were all lathed inside, it was not proved whether or not such walls would have done for outer walls without lathing"; SMITH, in *Transactions of the Royal Institute of British Architects*, 4to., London, 1839, p. 60.

HOLLY, see ILEX.

HOLME. A term used in landscape gardening for a low and level field skirted by a river.

HOLME (ARTHUR HILL), born 1813 at Liverpool, was placed in the workshop of his brothers Samuel and James in that town, and was afterwards a pupil in the office of T. Rickman at Birmingham. From 1835 to 1840 he was in partnership with J. Cunningham in the former town. Subsequently he designed the following works; 1847-8 S. Paul's church, Princes-park (Perpendicular Gothic) for 2000 persons; 1848 S. Matthias' church, Great Howard-street, for 1000 persons; 1849 the blind asylum, and the removal of its church (by J. Foster) stone by stone, from Hotham-street; 1854-5 All Souls church, Eaton-street, Vauxhall-road, without pillars, for 1000 persons: the schools adjoining were also by him; 1854-5 S. Aidan's church, which has been altered 1860: the schools were not built; 1848-9 All Saints church, Great Nelson-street North (Early English), for 1050 persons, and cost about £1000; 1853 Hime's music hall, Bold-street, which will seat nearly 1000 persons; 1858-9 an extension of the façade for Messrs. Woolbright's, Bold-street, originally the design of A. Cunningham

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and A. H. Holme; 1851 the church at Crosby, near Liverpool; 1851-4 S. Mary's church at Grassendale, Aigburth, Lancashire (Early Decorated), for 750 persons, at a cost of £3000; 1852 the seat at Knowlmore for Jonathan Peel, esq., M.P.; with many residences near Liverpool; the ship building slip at Eastham near Liverpool; and the huts and waterworks for the military on the Curragh of Kildare in Ireland. He died Nov. 1857 aged 43 years, and was buried at Walton on the Hill, near Liverpool, where a monument by Spence of Rome was erected by one hundred and sixty of his friends.

HOLMSUND (? Holmestrand, south of Drammen, in Norway) supplied in 1863, red deals and battens of first and second qualities, to the Hull and to the Great Grimsby timber markets. Dawbarn and Co. of Liverpool, state "they are a nice clean description of deal, something between the Gefle and Wyburg deals. They do not come in any large quantities, in fact in 1865 they had none. The sizes are ordinarily, 3 ins. by 11 ins., 3 by 9, 3 by 8, 3 by 7, 2½ by 7, 4 by 9, and 4 by 11."

HOLT (THOMAS), called "of York", one of the early practitioners in the Renaissance style in England, is supposed to have designed the Bodleian library at Oxford, commenced 1610; in which city he erected 31 July 1610-3 the whole structure of Wadham college, costing £11,360: 30 March 1613-9 the large quadrangle of the public schools (as first discovered by Hearne, DALLAWAY, *Anecdotes*, 8vo., London, 1800, p. 86); to the lofty tower of which he attached a series of double columns exhibiting the then so-called five orders of architecture (BRITTON, *Arch. Antiq.*, 4to., London, 1812, iii, 91, gives a view); in this edifice he introduced the system of counterarching the openings to resist perpendicular pressure: and the garden quadrangle of Merton college, completed before the schools, the portals of which are similar; the south side of the great quadrangle, however, BRITTON states was built 1610 by the Bentleys, four orders being used on the south side. INGRAM, *Memorials*, etc., 4to., London, 1837, ii (schools 12-3), states that "J. Acroide, 'chief builder of the schools', died 11 Sept. 1613 in S. Mary's parish; that J. Bentley, one of the chief masons that built the schools and Merton college new buildings, died 8 Dec. 1615 in S. Peter's in the East; that Mic. Bentley, unus e lapicidis qui ædificarunt Publ. Scholas", died 29 Jan. 1619; and that they also worked at the colleges of Oriel, Jesus, University, Exeter, etc., therefore probably these were also executed under the designs of Holt, who died 9 Sept. 1624, and was buried in the churchyard of Holywell. The epitaph, besides the name and "Ebor. Scholarum Public. Architecti", is printed in PESHALL, *City of Oxford*, 4to., London, 1773, App. of Mont. Inscr., p. 25. His daughter married S. Radcliffe, D.D., principal of Brasenose college, who died 1648. JEWITT, *Late Gothic Buildings of Oxford*, in *Journal of the British Archaeological Association*, 8vo., London, 1854, p. 164-177.

W. P.

HOLY WATER BASIN. A small recess made by the side of the entrance doors of mediæval and Roman Catholic churches, formed with a hollow or basin to contain water that had been consecrated. It is more generally called a STOUPE.

The term 'holy water vessel table' was given a few years ago to a CREDENCE table; but no ground has been shown for such an appellation.

A. A.

HOLYWELL LIME, see HALKIN LIME.

HOLZSCHUHER (EUCHARIUS KARL), *baumeister*, constructed 1616-9 the town-hall at Nürnberg, in the Renaissance style. A view is given in the DENKMÄLER DER KUNST. RETTBERG, *Nürnberg Briefe*, 8vo., Hann., 1845, p. 86. 116.

HOME-STALL. A mansion-house or seat in the country.

HOME-STEAD. A term sometimes used to designate the assemblage of buildings on a farm appropriated to the storing of farm produce, and the rearing and shelter of farm stock. Bearing this modified meaning, all that can be said upon it in the limited space at disposal will be found *s.v.* FARM BUILD-

INGS. In some instances, however, the term is used to include not only the buildings of a farm appropriated to farm produce and to stock, but also the dwelling house of the farmer and the cottages of his labourers. This latter is probably the real meaning of the term homestead, as distinct from buildings with only a bailiff's house, or labourers' cottages. In view of this wider signification, one or two points present themselves for consideration, not alluded to in the article above named. The first of these is the principles which dictate the position of the farmer's dwelling with reference to the buildings containing the stock. Authorities are divided in opinion on this point; on a review of all the circumstances which affect this question of farm house site, probably the best decision will be, that it should be such as will enable a view to be taken of the fields as wide and as comprehensive as possible; and that this is of greater importance than the command of the interior of the farm buildings containing the stock, as held by some persons, which, if obtained, is obtained at the cost of grave evils and many inconveniences. Another point greatly involved in the consideration of the circumstances affecting the disposition of the buildings constituting the homestead, is the position of the cottages of the labourers connected with the farm. Much has been written upon this subject, but all that need be said is, build them as near the place of work as possible. It is as unwise in business policy, as it is wrong in principle, to force the labourer—as he is unfortunately too often forced—to live at a great distance from the scene of his daily work.

R. S. B.

TUCKETT, *Prize Designs for Covered Homesteads, adapted to Farms of 200 to 500 acres*, etc. (Yorkshire Agricultural Society), 8vo., London, 1862. The *Journal of the ROYAL AGRICULTURAL SOCIETY OF ENGLAND*, 8vo., London, 1853, xiv, 325-42, gives a communication from W. F. Hobbs, *On Covered Homesteads* as being ten per cent. cheaper than the ordinary farm buildings, besides possessing other advantages; plans by the architect, H. Day of Worcester, are given; but the idea of these is attributed to Mr. Oakley, agent at Eastnor, where several of them have been erected: the barn and granary are covered with a roof close boarded and tiled, but the yards, stables, etc., are covered with Bridgewater roof tiles 14 ins. square, and when fixed lapping over 2 ins.: each one acts as a ventilator, whilst yet being a security against rain or snow. DENTON, *The Farm Homesteads of England; a collection of Plans*, etc., 4to., London, 1864.

Understanding the term *homestead* in the comprehensive sense in which it has been used above, the *farm house* comes to form one of its essential features. So far as the private apartments of the farm house are concerned, little need here be said, as much will depend not merely upon the size of the farm, but also upon the means of the farmer. One great feature of a farm house should be ample bedroom accommodation for the visitors with which he is very frequently inundated, so to speak. While, therefore, the entertaining rooms may be said to be in some measure rendered of less importance, still their connection with the working, or servants' part of the house must be carefully attended to, as it should be borne in mind that the work of a farm house is always going on, each hour brings its own special occupation; hence the necessity that no time should be lost in traversing long passages, or ascending and descending long flights of stairs. At the same time, it is as essential as in any other establishment, that as thorough an isolation as can be effected, should be secured for the living rooms. To this end of saving unnecessary labour, speaking tubes should be fitted up in addition to the bells communicating between the living and working apartments.

Among the first points to be decided upon in considering the working parts of a farm house is, whether the *dairy*, especially in a 'dairy farm', is to form part of it, to be an isolated building, or to form part of the farm or stock buildings. If either of the two latter plans is not to be adopted, the necessary isolation of the dairy accommodation from the kitchen and

scullery of the house must be secured; yet at the same time a close connection must be maintained. It should be borne in mind that milk is remarkably obnoxious to smells, and taints with great rapidity when placed near their influence. The dairy itself should be well aired, and also well lighted; the aspect must be north or north-east, not south or any of its points. The great point to be attended to in the construction of the milk-room is the maintenance of a uniform temperature; cool in summer, and warm in winter. The means therefore of cooling the milk vessels, by a judicious arrangement of stone, slate, or marble slabs and cold water pipes in summer, and of warming them in winter by hot water pipes, for example, will require consideration. Next to the milk room should be placed the churning and cheese making room. This should have ample space for the placing of the machines, and a slate or marble table for the manipulation of the butter. A communication (covered at the top but open at the side) with the wash-house will be useful, so that the utensils can be taken at once to be washed. In direct communication with the cheese making room should be the cheese store: this may be in the story immediately above the cheese making room, and connected with it by a simple vertical lift; as it should be well lighted, easily aired, and dry above all other points, the upper story will be the best situation. The kitchen should be of the amplest dimensions possible; a close, confined kitchen in a farm house is simply an absurdity. While securing ample space, the supply of light should be no less ample, and the relation of the windows to the fireplace well studied. The scullery should be immediately in connection with the kitchen, and it also should be of ample size, well lighted, and supplied with an open fireplace as well as with a close furnace copper; the former will be of great service frequently to supplement the open range of the kitchen when extra cooking is required; or sickness—sudden in its attacks as it often is—amongst the stock necessitates the speedy preparation of hot mashees. The scullery should also be provided with an expansive slop-stone or sink, not deeper than two inches. Next to the scullery should be placed the wash-house, which should be provided with a covered walk outside, under which the dairy utensils after being washed can be placed to dry. These suggestions must be taken as a very brief *resumé* of the points to be attended to in the arrangement of the working parts of a farm house. CHEESE ROOM; DAIRY.

A room or office where the farmer can receive persons on business and pay his men, and another in which the men can cook their victuals and assemble to partake of them, should be added to the range of buildings in the stead. Some persons consider that the former should be near the living room, accessible from the farm and road, without the necessity for passing through either the farm yard, garden, or offices; and that in the latter a copper would sometimes be found an advantage in a small farm.

R. S. B.

HOMMARTIN STONE. A brown freestone (*grès rouge*) which, although it is not very tenacious and does not possess a fine grain, is very successfully employed for ornamental work, as at the castle of Heidelberg. The quarry, known as the *carrière du banc de Hommartin*, is situated near Sarrebourg in the department of La Meurthe; and has supplied the material for the greater part of the churches and châteaux in German Lorraine, as well as for almost all the buildings in Frankfort, Mayence, and Carlsruhe. 107.

HOMODEUS (JOHANNES ANTONIUS), see OMODEO (G. A.). HONDIUS OF DE HOND (HENDRIK), born 1573, at Duffell in Brabant, studied drawing, mathematics, perspective, and civil and military architecture, under S. Marolois and others; with painting and engraving under J. Wierix and J. F. de Vries. He usually lived at the Hague; no buildings in particular are attributed to him; he died in 1610. 5. 101.

HONECORT (WILARS DE), called Villard de Honnecourt by Lassus, is presumed to have been an architect of the 13th

century (1230-60?) so called probably from the village of that name, situate near Cambrai in France. He was the author of a vellum sketch book preserved in the bibliothèque impériale at Paris; lithographed in facsimile by LASSUS and DARCEL, 4to., Paris, 1858; and translated into English with notes by WILLIS, 4to., London, 1859: it was described by QUICHERAT in the *REVUE ARCHÉOLOGIQUE*, 6^e année; a critical review by BURGESS, with some woodcut imitations, in the *BUILDER Journal*, 1858, xvi, 758, 770; and a paper by GARLING, *Some remarks on the contents of the Album*, in *Transactions of the Royal Institute of British Architects*, 15 Nov. 1858. The sketches by Wilars show chapels at Reims; a window at Chartres; a rose window at Lucerne; the tower of Laon cathedral; plans of the choir of the church of Vaucelles, of S. Etienne de Meaux, and of Notre Dame de Cambrai.

LASSUS supposes him to have been employed at Cambrai 1230-50, when he was on his way from Reims to Hungary; and besides attributes to him the church of S. Elizabeth at Cassovia, on account of the resemblance of its plan with that of the church of S. Yved de Braine, of which also he is conjectured to have been the architect. He returned from Hungary, where he "remained many days" (cir. 1244-7), and sketched some pavements in his book. Among his own inventions is a plan of a Cistercian church, having its usual square end; the apse of the church at Cambrai; and another which he states is the result of a discussion with Pierre de CORBIÈ. Other sketches consist of a bridge; a clock tower; some roofs, without tie-beams; an ogee cradle roof, anticipating the almost unique example in the house of Jacques Cœur at Bruges; stall work, with a group of wrestlers, as occurs at Lausanne (RAMÉE, in DIDRON, *Annales Archéologiques*, xvi, p. 50, says it is barbarous in the extreme); a few problems in mechanics as memoranda; and many sketches of figures from the antique and from the life, and of animals, some drawn according to an assumed mode of proportioning the parts by geometric forms.

HONEH. A brown coloured wood of Canara, East Indies, obtained 8 ft. in circumference and 20 ft. long, and used in house and in boat building. 71.

HONEYCOMB. *The Architecture of the Honey Bee* was the title of a paper read by S. Smirke, R.A., given in the *Transactions of Royal Institute for British Architects* 13 June 1853, in which he elucidated the construction of the cells as hexagonal prisms, and as exhibiting three main co-ordinate and dominant principles—convenience, strength, and economy.

HONEYSUCKLE. The name given in England by some authors, and by most workmen, to the ornament which will be described *s. v.* PALMETTE.

HONOR. The title given to an estate, and which is thus explained "in 1540 the manor of Hampton Court was by act of parliament created an honor"; by MADOX, *Hist. of the Exchequer*, 4to., Lond., 1769, i, 296, who describes an honor; and in *Baronia Anglica*, fol., London, 1741, p. 24, states that "every honor had three constituents, to wit, seignourage, service, and demeanne". On p. 9, he observes that it was an honor of a new species, since it had always been the distinguishing and essential property of an honor, that it was an escheated barony. He adds, that "Hampton Court, Amptill, and Grafton (both in 1542), were the first land-honors that ever were created or erected by statute, and probably will be the last."

HONORATO (CRISTOBAL DE). It appears from P. DE QUIRÓS, *Parentación en la muerte de Felipe III, por la ciudad de Salamanca*, 1666, that from the many designs submitted May 1661 for the monument to that monarch, to be erected in the cathedral of Salamanca, that by Honorato, a distinguished architect and painter, was selected. Hence it is inferred that many good buildings in that city, of that period, may have been designed by him. 66.

HONTANON, see GIL DE HONTANÓN (J. and R.).

HOBOBALLI. A wood of British Guiana obtained from the banks of the river Demerara. It is very close and fine

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grained, easily worked; it takes a fine polish; and is much used in the colony for furniture. It may be had from 15 to 20 ins. square, and from 40 to 70 ft. long. The duramen is a deep red chesnut in colour; that of the alburnum, a nut brown. 71.

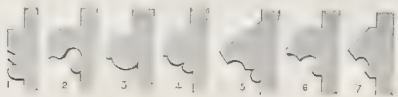
HOOD. A projecting cover to a fireplace, an opening, and other apertures, for the purpose of collecting the heat, etc.; or for shielding the opening from the effects of the weather. A hood of wood over a fireplace, or over a boiler, was common at the end of the last century. Fisher's patent smoke conductor, or hood over the fire, was first introduced into London by Gregson of Charles-street, Grosvenor-square; it tended to the cure of smoky chimneys by keeping warm air in the mouth of the flue, and as the top of the chimney opening was closed, more heat was obtained from the fire; it is shewn in ACKERMANN, *Repository of Arts*, etc., 8vo., London, 1813, x, 350. CHIMNEY HOOD; FIREPLACE; GATHERING; HOPPER. The term *fausse hotte* has been used in France to describe a hood intended to conceal the inclination of a flue that is carried up obliquely.

A 'hood' to a window is a feature which of late years has been discontinued for the verandah or covered balcony. It has this advantage, that the upper sashes can then be left a little open without any chance of the rain beating in; and even when of small size, it protects the glass from the direct vertical rays of the summer sun, and from the first attack of the winter storm. It also adds much to the artistic effect of a rural building, appearing in effect as the entablature and pediment of an Italian structure. It is a feature much used in dwelling houses in America.

HOODMOLD. The name commonly given in mediæval work to the molding or group of moldings, over an aperture, projecting from the face of the wall. The hoodmold, properly so called, stops upon corbels; and if returned horizontally it becomes a DRIPSTONE. The employment of such a series of moldings over an aperture inside a building is a solecism in Gothic architecture that occurs in the best examples of the best periods: the editor of RICKMAN, *Attempt*, 8vo., London, 1848, p. 52, suggests that the word *dripstone* should be used for such a group of moldings outside a building over a window, and *hoodmold* be reserved for a similar group in the interior; keeping the term *label* for square-headed apertures. RICKMAN, p. 52, observes that this dripstone (*hoodmold*) if ornamented is called a canopy; but p. 138, enumerating the several kinds of canopies to Second Pointed doorways, he says, "the dripstone is generally supported by a corbel, which is commonly a head; in some instances a plain return is used, but that return seldom runs horizontally. The canopy is sometimes connected with the dripstone, and sometimes distinct. The common canopy is a triangle, the space between it and the dripstone is filled with tracery" (this is explained perhaps by the work at Milton church in Kent, given in BRANDON, *Analysis*, 4to., London, 1847, s. v. Decorated, pl. 14) "and the exterior ornamented with crockets, and crowned with a finial. The second canopy is the ogee, which runs about half way up the dripstone, and then is turned the contrary way, and is finished in a straight line running up into a finial. This has its intermediate space filled with tracery, etc., and is generally crocketed. Another sort of canopy is an arch running over the door, and unconnected with it, which is doubly foliated; it has a good effect, but is not common", and he thus rather confuses his subject.

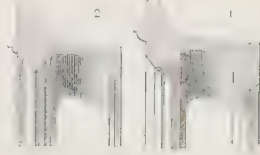
In Norman work, however, the curved hoodmold is frequently returned as a dripstone from one aperture to another; if not so continued, it is stopped by an impost or by some ornament resting upon an impost. A hoodmold filled with the tooth ornament occurs at Ketton church, in Rutlandshire, in work belonging to the transition from Norman to First Pointed art. In the latter style the hoodmold, generally narrow, is various; sometimes consisting of several moldings, sometimes being only a round with a small hollow: while on the inside of

walls, it is occasionally decorated with the tooth ornament and with flowers. It is common for the hoodmold, where not stopped by a head or a flower as a corbel, either to be returned as a dripstone and to run as a tablet along the walls until it is stopped by a buttress or a pier, or is even carried round the obstacle; and the same arrangement, rarely if ever used in Second Pointed work, is common in Perpendicular buildings.



In Second Pointed work the hoodmold, sometimes having several moldings, consists principally of a slope above a deep sunk hollow (the latter being sometimes enriched with flowers) with or without a bead or fillet under them: the hoodmold very seldom runs as a dripstone, though a return is used almost as often as a corbel. In Third Pointed structures, the hoodmold is much the same as that just described, and it finishes by a plain return, which is commonly a dripstone, as in First Pointed buildings; although corbels, frequently heads, were sometimes used in the early part of this period, there are some good instances of the moldings returning upon themselves so as to form a square or a diamond. A hoodmold with external foliation, occurring at the churches of S. Giovanni Maggiore and of Sta. Chiara, both at Naples, is given by WILLIS, *Remarks*, 8vo., Cambridge, 1835, pl. xii, fig. 6: the use of foliation in similar positions on the gable of the south portal of Notre Dame at Paris; and of trefoils between cusps as crockets over the *portail de la Calende* at Rouen, is shown by VIOLETT LE DUC, *Dict.*, s. v. GABLE: all these may be compared with the illustrations given s. v. HARPAGINETULUS.

This word hoodmold is now generally used to describe the inner molding over such openings the section of which certainly resembles a hood more nearly than any of the usual outer moldings. In Romanesque as in Classic work, all soffits of arches finished with an arris. In Norman work, unless there were jamb shafts and a set of internal moldings, the inner arch finished also with a plain arris, or sometimes a smaller hollow. In Early English work, where there are no jamb shafts, etc., the internal molding became two chamfers and a square, the inner arch being very much more depressed than the outer lancet, and a great hollow or 'hood' between the two, fig. 1. In the Decorated period, the difference between the inner and outer arches was less as well as the hollow over the opening, and the inner molding was formed of two hollows meeting at an arris, fig. 2.



The same was much the case in the Perpendicular period, always supposing there were no jamb shafts, escoinson, or internal system of moldings.

HOOGHLY. A town in the Bengal province in India, situate on the west bank of the river Hooghly, twenty-one miles above Calcutta. It contains a church, a Hindoo temple, and a college in which English, Persian, and Arabic are taught. It is a place now of little note, but about three miles distance on the east bank is the town of Bansbarea, to the north of which are some ruins of Mahomedan buildings of stone, a material very rarely met with in that part of India; HAMILTON, *East India Gazetteer*, 8vo., London, 1828, i, 134, quoting FULLARTON, etc.

HOOK (SIMON), mason, "for wages, being there and directing the masons' work (at Rochester castle), and working 288 days, had 8*d.* per day (1368-9); the other masons had 6*d.*, 6½*d.* and 5*d.* each per day". KENT ARCH. SOCIETY, *Arch. Cant.*, 8vo., London, 1858, ii, 123.

HOOK or **WALL HOOK.** A species of a strong spike

like a **HOLDFEAST**, but finished differently at top. It is sometimes used in rough carpenters' work; but generally in fixing flashings, pipes, etc. Wall hooks are manufactured in lengths of from 3 ins. up to 9 ins., and are sold by weight in the same way. The head of the larger sort come to a thin point, which can be bent round the pipe by the hammer. Smaller pipes are generally fixed by gasfitters' hooks. There are many other varieties of hooks; the most common are used for fixing shelves or dressers.



These have sometimes square, and sometimes bent, ends; generally with plates and screws, though a commoner sort have merely a pin, and are then driven into the edge of the shelf by a hammer. Hat hooks, cloak hooks, hooks to hold doors, book and picture hooks, etc., being rather matters of furniture than of the construction of a house, are not described herein. **HIP HOOK.**

A. A.

HOOK AND **BAND HINGE**, also called 'hooks and bands'; 'hooks and eyes'; 'hook and rides' in Kent; and 'bands and crooks' in Yorkshire (It. *arpione*; *cardine*; Fr. *gond*; *panture* a long band; *paumelle* a short dove-tailed band; Ger. *furthürangel*). A hinge formed by a band of iron fastened to the door by bolts or screws, ending with an eye or joint, in which the pivot works, and secured in the jamb of the opening. It is used in stone buildings for gates, and in work where great strength is required; a smaller sort being used for the oven doors of kitchen ranges. They are made in lengths of 10, 12, 14, 16 and 18 ins., measured from the joint, and are sold at per pair: all larger ones being charged by weight. **GARNET**; **GUDGEON**; **HINGE**.

HOOKER (ROBERT), M.D. (1691), was born 18 July 1635 at Freshwater in the Isle of Wight. He became an assistant to, and sometimes the rival of, Sir C. Wren; took an active part in the establishment 1660 of the Royal Society, to which he became 1677 the curator (or secretary); was appointed 1664 professor of geometry at Gresham college; and was the author of many philosophical essays. After the injury to the city by the great fire, he submitted 19 Sept. 1666 to the council of that society a model for rebuilding the city of London; and was appointed by the Corporation, with Mills, Jarman, and Oliver, surveyors in rebuilding the houses, for measuring, adjusting and setting out the sites in the streets to the several proprietors; and 2 and 9 Nov. 1666 was ordered "to make a draft and estimate" for rebuilding the exchange, which amounted to between £4,000 and £5,000; *Extracts from Records of the City of London*, etc., 1564-1825, fol., Lond., [1839]; *BUILDER Journal*, 1846, iv, p. 2. He submitted to the Royal Society a design for a collegiate building, which, says ELMES, "did not please the society, nor did the manner in which Hooke appeared to trench upon his master's ground of designing the works—for Wren's design for the building was ordered to be procured 4 May 1668, and then Hooke was ordered to get a model made of the approved design, to contract with proper persons for the execution of the work, as also to find some one to be constantly present and to see the workmen do their duty—thus appointing Wren as architect, Hooke as surveyor and valuer, with a clerk of the works—(BIRCH, *History*, ii, 275-300); valuable information of the way in which works were superintended in those days and of the esteem in which Wren was held"; *CIVIL ENGINEER Journal*, x, 268; ELMES, *Memoirs of Wren*, 4to., London, 1823, p. 239. Hooke designed a house in Great Russell-street, Bloomsbury, for Ralph, first duke of Montagu, which was visited by EVELYN, as noticed in his *Diary*, 11 May 1676, 5 Nov. 1679, and 10 Oct. 1683, who describes it as "built after the French pavilion-way"; it was burnt 19 Jan. 1685-6, with the contents (WALPOLE, *Anecdotes*), and rebuilt by P. Puget. Hooke is also said to have designed 1641 the back buildings of the college of physicians, Warwick-lane; the front portions and theatre being

by Sir C. Wren. He designed 1691 Aske's hospital or Haberdashers' almshouses at Hoxton, erected and endowed by ald. R. Aske; a drawing of it by the architect is said to exist in the court room of the company: this building was rebuilt 1825-6 by D. R. Roper. He erected 1675-6 Bethlehem hospital, Moorfields, 540 ft. long and 40 ft. wide "at a cost of nigh £17,000"; (given in *Stow, Survey*, edit. STRYPE, fol., London, 1720, b. i, p. 192); it was taken down 1814-5. Hooke died 3 March 1702-3 in Gresham college in the 68th year of his age, and was buried in S. Helen's church, Bishopsgate-street. CHALMERS, *Biog.*, 1814; *Biog. Brit.*, 1750-7, iv. W. P.

HOOK PIN. The same as DRAWBONE PIN.

HOONVALLOO. A brown coloured wood of Canara, East Indies, from 1 to 2 ft. in circumference by 10 to 20 ft. long, used for common purposes. 71.

HOOP (Fr. *virole*). A stout ring of wrought iron placed on the head of a pile, to prevent the wood splitting, when the weight or monkey falls upon it, in pile driving.

HOOP IRON. A description of wrought iron prepared for the use of coopers, and such trades, with peculiar care and of remarkable thinness; it is now much used in building, for the purpose of bond in brickwork, and for feather tongues in joiner's work, especially in floors. It is made from 2 ins. to $\frac{3}{4}$ of an in. in width, and from $\frac{1}{2}$ to $\frac{3}{8}$ of an in. in thickness, with all the intermediate gradations; the usual size adopted by architects for bonding work is $1\frac{1}{2}$ in. by $\frac{3}{8}$ of an inch. On account of the greater care required in rolling this iron it is generally quoted at a higher price, about 20s. a ton; it is sold and described by the wire gauge, which begins with the thickness above named, or $\frac{1}{2}$ of an in., and continues through twenty-six different sizes to $\frac{1}{16}$ of an in.: the width and thickness required has to be specified. G. R. B.

The sorts most used in building are—

| | | | | | |
|--------------------|---|---|---|---------|-------------|
| a 1 in. wide | - | - | - | 20 to 6 | Wire gauge. |
| b $1\frac{1}{2}$ " | - | - | - | 18 to 6 | " |
| c $1\frac{1}{4}$ " | - | - | - | 17 to 6 | " |
| d $1\frac{3}{4}$ " | - | - | - | 16 to 6 | " |

The iron is made up and sold in bundles of $\frac{1}{2}$ cwt. and 1 cwt. Twenty-five feet run of a will weigh 6 lbs.; of d, 14 lbs. This material is used by carpenters for tying together rough work, particularly fences; and by bricklayers in bonding work. 'Hoop-back' is an extra strong iron hoop made for brewers' backs, vats, etc., and is sometimes used in building. To afford a better hold and to prevent its rusting, iron hooping should always be tarred and sanded. Other notices of its use will be found s. v. BOND COURSE. A. A.

Hoop iron when used as bond in very strong brickwork is about 2 ins. wide and $\frac{1}{2}$ in. thick, laid in two or more ranges according to the thickness of the wall: it was formerly inserted every four courses of bricks, but is now commonly placed at about every 3 ft. in height. It is very useful in thick walls, but it is not rigid enough (like wood-bond) in thin walls to resist the shaking of ladders and scaffolding, as noted s. v. BOND COURSE.

Weight of Ten Lineal Feet.

(No. 21 is about $\frac{1}{16}$; No. 18, $\frac{1}{8}$; No. 15, $\frac{1}{4}$; and No. 12, about $\frac{1}{2}$ of an inch thick.)

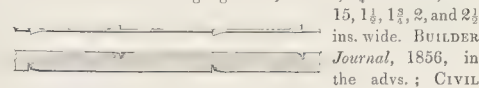
| Width in ins. and parts..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|--------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Number of gauge | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 |
| Weight in lbs. & decimal parts | 6.85 | 6.80 | 6.75 | 6.70 | 6.65 | 6.60 | 6.55 | 6.50 | 6.45 | 6.40 | 6.35 | 6.30 | 6.25 | 6.20 | 6.15 | 6.10 | 6.05 | 6.00 | 5.95 | 5.90 |

BUILDER'S Price Book for 1865.

Tyerman's patent hoop-iron bond, invented in 1855, consists of ordinary iron hooping run between rollers which notch its edges at intervals of $11\frac{1}{2}$ ins., and turn the points or claws up and down alternately, to catch the middle of the frog of the brick. It has been considered to have by far the best hold of brickwork of any yet invented, and not to be drawn out; the fault of plain hoop being that when set in the mortar, the mortar in drying shrinks from it, and it consequently gets very

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little hold of the work; but in all good work, hoop iron should be set in cement. The gauges are, No. 16, $1\frac{1}{4}$ in. wide; No.



ENGINEER Journal, xviii, 400.

The use of iron hooping as a bond in brickwork forms so important an epoch in the history of the art of building, and its introduction is so recent, that it seems right, by the assistance of those who were personally cognisant of the circumstances, to put on record the origin of the discovery. Until the year 1835 it was the custom of all good builders, especially where there was any irregularity in the character of the sub-soil, to place one or more lines of balk timber along the centre of a wall at its footings. This process, however, was open to one serious objection; the timber would necessarily decay in time, and there would be caused a hollow space at the very part where solidity was most to be desired. To the elder Brunel is due the merit of having devised the far more effectual bond obtained by laying hoop iron in the courses of brickwork so as to form a continuous longitudinal bond not liable to decay. It was in the autumn of 1835 that he built, and invited his friends to see, what he called a *brick beam*, which consisted of seventeen courses of brickwork in cement, having a clear bearing of 22 ft. 9 ins., and having its five lower courses built with twelve lines of iron hooping. This brick beam stood for two years with 25,000 lbs. suspended at its centre, an object of great interest to a number of scientific and practical men. The idea was at once adopted by Messrs. Baker, the builders, in the erection of Messrs. Goding's brewery in 1836; but the first architect who so fully appreciated the value of the idea as to induce him to adopt it in his general practice was Sir Robert (then Mr.) Smirke. In 1838 he caused the hoop iron bond to be used at Crawshay's warehouse in Thames-street, and he never afterwards failed to use it. His brother, Sydney Smirke, also used it in 1839 at the juvenile prison in the Isle of Wight; and in the third contract for the new Houses of Parliament, Sir Charles Barry's specifications, dated June 1839, required the hoop iron bond to be used. In short, the system became gradually and universally adopted; and it is remarkable that the process, with but trifling modifications, is now the same as that originally devised by the inventive genius of Brunel. s. s.

This material has been suggested for use in other ways. The suspension bridge over the river Seine at Suresnes in France, about 200 ft. in span, was designed by Flachet and Petiet, with hoop iron cables in lieu of the usual wrought iron bars: it is given in the *ANNALES DES PONTS ET CHAUSSEES*, 1842, and in HANN and HOSKING, *Bridges*, Supp., 8vo., Lond., 1850, 123, pl. xxv; their first work on this principle was a foot bridge at Abainville of about 134 ft. span, given pl. xxvi of the same work. When galvanized, it has been suggested for use instead of wood laths in a CEILING, and in partitions; to be $\frac{3}{4}$ in. wide and $\frac{1}{2}$ in. thick; cut into lengths for five joists, the ends to lap over each other and to be nailed on the lap with a single nail, every six sets of irons to break joint. The holes for the joists to be carefully punched, and then each length is to be hammered quite flat and straight, and not afterwards bent in any way. This hooping to be fixed with $1\frac{1}{2}$ in. long wrought iron clout nails, galvanized, to be not less than $\frac{3}{8}$ in. square or round under the heads, and to be driven well up. In ceilings the irons not to be fixed closer than $\frac{3}{4}$ in. from one another, and in partitions not closer than $\frac{1}{2}$ in. The first coat of lime and hair to be stiffly gauged with Portland cement; BUILDER Journal, 1853, xi, 684. Hoop iron was also suggested for a floor; thus "Strong bridging and ceiling joists are easily made from wide hoop iron rivetted together, with a slip of poplar between them to hold the flooring or lath nails"; SMART, in *Transactions of Society of Arts*, 1827, xlv, 126.

HOPE (Gr. ὅπην). This word is incorrectly used for OPE, by BATISSIER, *Histoire de l'art*, etc., 8vo., Paris, 1843, p. 190.

HOPEA ODORATA, or *Thengan* or *Tengauin*. A very large tree of Tenasserim and Martaban in the East Indies. It is of the Dipterocarpeæ or Saul tribe. A very strong but coarse grained wood is obtained from it, used chiefly for making canoes. It affords an immense quantity of dammer or resin. 71.

HOPPER (THOMAS), born 6 July 1775 or 6, at Rochester in Kent, was educated in the office of his father, a surveyor of that town, but his artistic knowledge was self-acquired. He made large alterations (in the Batty Langley style of Gothic) to Craven cottage, Fulham, for Walsh Porter, esq., converting it into an example of the cottage ornée style, one which he was perhaps the chief means of introducing. This building having been admired by the Prince Regent, he commissioned Hopper to make alterations at Carlton house (after those by H. Holland), comprising chiefly the Gothic conservatory (exhibited at the Royal Academy 1806 as "now building"), decorated for the fête given 19 June 1811 (ACKERMANN'S *Repository of Arts*, 1 ser., vi, 167; and PAPWORTH, *Select Views*, etc., 8vo., London, 1816); it was 72 ft. long, 23 ft. wide, and 20 ft. high, and designed after the style of Henry VII's chapel, light being admitted through the tracery of the vaulting. This patronage led to so large a practice among the nobility and gentry, that probably no other architect of about the same period, except J. Wyatt, was so extensively employed in erecting new, and in enlarging old, mansions.

Among these works were, Slane castle, co. Meath, for the marquis of Conyngham; and Gosford castle, Armagh, both in Ireland; before 1840 Penrhyn castle, near Bangor, North Wales, for G. H. D. Pennant, esq. (Baronial castellated), perhaps his best work (he sent a drawing of the upper court and keep to the Paris exhibition 1855); alterations to Easton lodge, Dunmow, Essex, for viscount Maynard; Leigh court, near Bristol (Classic), for the late Mr. Miles; alterations at Kinmel park, near S. Asaph, for lord Dinorbin; and at Amesbury park, Wiltshire, for the duke of Queensberry; designed Danbury-place, Essex, for L. D. Fytche, esq. (?); Wivanhoe park, Essex, for J. G. Rebow, esq. (?); cir. 1820 South Stoneham park, near Southampton, Hampshire, for John Fleming, esq., M.P. (ACKERMANN'S *Repository of Arts*, 3 ser., vi, 249); cir. 1840 Llanover court, Monmouthshire (Jacobean), for Sir Benjamin Hall, bart.; alterations at Stansted park, near Havant, Hampshire, for Charles Dixon, esq. (?); before 1840 Margam, Glamorganshire (Tudor), for C. R. Mansell Talbot, esq.; cir. 1820 works at Alton Towers, Staffordshire, for the late earl of Shrewsbury; alterations at Rood Ashton house, near Trowbridge, Wiltshire, for — Long, esq.; Essex county gaol at Springfield, Chelmsford, which he subsequently altered for the cellular system, at a cost of £40,000; and also many other gaols. He made a design for Dunkeld palace in Scotland, for the late duke of Atholl, on a princely scale, but which did not proceed beyond the foundations; as well as 1847-8 one, also not executed, for the late lord Monson at Gatton, Surrey.

In London, he designed 1826-7 Arthur's club house, S. James's-street; cir. 1836 the Atlas fire office, Cheapside; 1838 the Legal and General life insurance office, Fleet-street; 1838-9 alterations at Messrs. Coutts' banking house, Strand; and 1845-6 S. Mary's hospital, Cambridge-place, Paddington, with extension in 1851, at a cost of £34,000, and to which he acted as honorary architect.

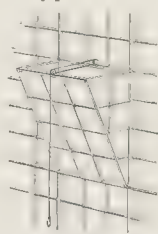
He competed 1820 for the general post office, S. Martin's-le-Grand; in his pamphlet, *Letter to Lord Melbourne on the rebuilding of the Royal Exchange*, 8vo., 1839, he engraved a plan and elevation to support his assertion that Sir R. Smirke, the architect of the new building, who had not competed, had used his design. He also competed 1836 for the Houses of Parliament, and published *Designs for the New H. of P.*, fol., 1840; a *Letter to Lord Duncannon on the rebuilding the H. of P.*, 4to., 1837; and *Hopper v. Cust, on the New H. of P.*, 8vo.,

1837. He also competed 1843 for the new Conservative club-house in S. James's-street; was for about forty years county surveyor of Essex; and was surveyor to the Atlas fire assurance company. He declined knighthood from king George IV; as well as offers from Alexander I. and the duchess of Oldenburg, to settle in S. Petersburg. Hopper died 11 August 1856 at Bayswater-hill, aged about 80 years.

It is said that his form and features were given by J. Tennyson to the sailor who is supporting the wounded boy, in the bas relief on the east side of the Nelson column. Amongst his more recent pupils were F. J. Francis, and G. A. Burn, who latterly had charge of his practice. BRITTON, *Toddington*, 4to., London, 1840, 24-6; *BUILDER Journal*, xiv, 481. 14.

HOP KILN, see OAST HOUSE.

HOPPER CASEMENT. A species of ventilator commonly put in the windows of large edifices, especially churches.



It is something like the hopper of a mill, as its name imports, and has two triangular glazed cheeks, and a hinged glazed flap which falls inward, and is closed or opened by pulleys and lines. In some respects it is convenient, for the draughts do not fall directly on the heads of the congregation, and as the rain will not come in when left open: but it is better calculated for the entrance of fresh, than the discharge of

heated vitiated air; the tendency of the latter being upwards, and the means of exit by a hopper the reverse. If provision, however, be made above for the escape of foul air, hopper casements are very serviceable. The frames are generally of light wrought iron.

A. A.

A hopper pane of glass for ventilation or admitting air into rooms for the supply of the fire, was recommended by FRANKLIN, *Causes and Cure of Smoky Chimneys*, 8vo., London, 1787, p. 13, who says it is called *Was ist das?* (also so called 1865 in S. Petersburg) in France, whence he inferred that the invention was probably German. The term *Vasistas* appears to be also given to the grated opening in a *porte cochère*, through which the porter can look without opening the gate.

The term hopper has been lately used for what might more properly be called a hood, inserted in the throat of a chimney for the purpose of gathering over the brickwork and ensuring a perfectly formed connection with the flue. Its shape is that of a truncated pyramid; as White's registered cast iron chimney hopper and chimney bar combined; *BUILDER Journal*, ads., 2 Sept. 1854. Edwards' patent chimney bar and hopper, xviii, 535, is a kind of grated iron plate.

HOPPER HEAD. The name sometimes given to the small cistern at the top of a rain water pipe. HEAD.

HOPPUS (EDWARD), revised and redelineated the two hundred and twenty-six plates to COLE, *A. Palladio's Architecture*, fol., Lond., 1736; published *Architectura Civilis*, also called *The Gentleman's and Builder's Repository, or Architecture Displayed*, 4to., London, 1738 (3rd edit. revised, with a façade of the new Mansion House from the model, 1748); edited SALMON, *Palladio Londinensis, or London Art of Building*, 37 pl., 4to., London; 5th edit. 1755; and another in 1773; and *Tables for Measuring*, first edition not known; 17th edit., 12mo., London, 1820; and again as late as 1837. He was elected 4 June 1729 surveyor to the corporation of the London Assurance, as successor to John Shepherd, and held that appointment till his death in April or May 1739.

HOPTON WOOD STONE. The quarries whence this stone is obtained are situated near Middleton and Wirksworth in the mountain limestone districts of Derbyshire. The stone consists of compact carbonate of lime, associated with crystals of that substance in a confused state, and with fragments of encrinites; it is very dense, a foot cube weighing 158·7 lbs.; the labour of working it is about half as

expensive again as on that of Portland. It was largely employed in the paving of the new Houses of Parliament, for which service it is admirably adapted, owing to the closeness and evenness of the grain; these properties are its principal recommendation, as the price of it would always oppose its introduction into the London market. It appears that success in using this stone does not much depend upon the observance of setting it on its natural bed, as the crystallization is generally independent of that condition.

G. R. B.

The quarries are now worked by the Hopton Wood Stone Company, limited. There are no regular beds, the blocks being found in every variety of position amongst a mass of rubble, the proportion of which is so great that but for the value of the *débris*, which is used for fluxing in the manufacture of iron, the quarry could not be worked.

S. J. B.

It is said to be suitable for staircases, halls, passages, etc., and to have been extensively used at Chatsworth, Belvoir castle, Trentham hall, Drayton manor, Birmingham grammar school, and most of the principal mansions of the nobility and gentry in the midland counties, besides many railway stations and public buildings; Ads. in *BUILDER Journal*, 1859. Tis-sington hall, Derbyshire, erected about the latter end of the reign of Elizabeth, given in NEALE, *Seats*, 2 ser., i, 4to., London, 1824, is stated to have been built of this material.

"These extensive quarries have been worked from time immemorial; the material is decidedly *marble*, for it is fine grained, compact in texture, and quite hard enough to take a brilliant polish. The colour is pale brownish white, certainly as white as Sicilian marble, which approaches to a bluish grey. It is much heavier than Portland stone, but lighter than Carrara marble. Blocks of very large dimensions may be obtained free from serious defects; and as it is an aqueous formation, hard, and well crystallized, there is no doubt of it standing weather extremely well. Both material and workmanship, in London, are less expensive than those of Sicilian marble. The Hopton Wood stone, or marble, has never been used for building in London; but there is a large quantity of this material, which was laid down about eight or ten years since for foot-pavements and steps, close to the Parliament Houses in Old Palace-yard, and part of Abingdon-street, Westminster; and although in a situation where it forms a public foot-path which is in constant use, no symptoms of decay or of the surface wearing away are perceptible"; C. H. SMITH, in *BUILDER Journal*, 1864, xxiii, 912.

HOPWAS FOREST STONE. In 1235 king Henry III granted to the dean and chapter of Lichfield cathedral a license to dig stone in the quarries in the forest of Hopwas (which extended over a large tract of country on the south side of the city) for the fabric of the church; three years afterwards another precept was issued by him for the same purpose; no evidence is to be found as to the parts of the edifice then raised, but probably in the north transept and chapter house; BRITTON, *Lichfield*, 4to., London, 1816, p. 27, who gives the originals from the rolls. Claus. 19 Henry III, as quoted in SHAW, *Staffordshire*, fol., London, 1798, p. 235.

HORIZONTAL CORNICE. A term given to the cornice under the tympanum of a pediment, to distinguish it from the sloping cornice over the same.

HORIZONTAL LINE IN ARCHITECTURE. Sir G. WILKINSON offered some remarks on *Vertical and Horizontal Lines* at the Royal Institute of British Architects, 16 March 1840, which were commented upon by GODWIN, 27 April, as given in the *CIVIL ENGINEER*, etc., *Journal*, iii, 136, 210; with remarks by EAST, 186, 228.

HORIZONTAL LINE. A term used in perspective for a line drawn, or supposed to be drawn, across a picture exactly where a horizontal plane would pass through the eye of the spectator and cut the vertical plane of delineation. It may be represented approximately by stretching a level thread exactly at the height of the eye. The vanishing points of all perpen-

dicular planes are always in the horizontal line. It is so called because the apparent horizon or line of the sea against the sky is very nearly in this plane. In sketching from nature it is a very convenient way to hold a thread or rule before the eye as before stated, and mark what portions of the landscape are cut by it, and to what points of this line the vanishing lines tend.

A. A.

HORIZONTAL PLANE. Any plane which is a tangent to the curved surface of the earth, or at right angles to a line drawn from the centre of the earth to such a point.

A. A.

HORIZONTAL PROJECTION. The points where any number of perpendicular *parallel* lines from any object would cut a horizontal plane extended over them; these being joined together would give a figure called a horizontal projection, or Ichnography, or plan. Where horizontal parallel lines are drawn from any object and strike a perpendicular plane, the figure so traced or projected is called Orthographic projection, or elevation. In like manner, if the rays are drawn to a point on the eye of a beholder, not being parallel, but forming as it were a pyramid, the figure so traced is called Scenographic, or perspective projection. The terms are used by VITRUVIUS.

A. A.

HORLEMAN (Baron CHARLES), born 27 August 1700 at Stockholm, was the son of an inspector of the royal gardens. He studied the arts between 1721-7 in Holland, France, and Italy; and on his return, 1728, was appointed intendant of the court, and directed to superintend the construction of the royal palace at Stockholm, which was completed 1753. He made designs for many public buildings, among them were the observatory at Stockholm and the cathedral at Calmar, all in the Italian style, which he employed even when repairing and restoring Gothic edifices. Amongst his published works are *Dagbok oefver en ifrån Stockholm genom atskilliga Rikets landskaper gjord resa* (Journal of Travels through different countries of the kingdom), 8vo., Stockholm, 1749, translated into German, Leipzig, 1751: and *Brefv.*, etc. (Letters to count Piper about his other travels), 8vo., Stockholm, 1751 and 1753. He was a member of the house of nobles; but he declined 1746 the title of a senator (*riksråd*); and was a member of the academy of sciences and beaux arts of Stockholm. He died 9 February 1753.

112, 113.

HORN. A name sometimes given to the Ionic volute. Imitations of the natural ram's horn as a volute are shewn in PIRANESI, *De Rom. Mag.*, fol., Rome, 1761, pl. 16 and 35; and another variety seems to have been designed by Dance for No. 52, Pall Mall (now the British Institution), and to have been repeated by Nash at No. 17, and Nos. 23 to 25, Regent-street, London. ALTAR; EAR.

But in general the word HORN (Fr. *corne*) is employed to express each of the four projecting portions of any abacus which has its faces curved on plan. These portions usually do not run to a point, but the perfect point is shown by STUART and REVETT, *Antiquities*, fol., London, 1794, iii, as occurring in Salonica at the building called the Incantada: and in Athens at the arch of Theseus (or of Hadrian); at the temple to Jupiter Olympius; and at the building called by STUART, i, a stoa or portico or the Poikile, but which has since been ascertained to be the Pantheon of Hadrian according to KINNARD's edition of STUART. This commentator adds that no inference as to style, however, can be drawn from the circumstance of the occurrence of the point in these examples, because the abacus of a capital of the Corinthian order in the temple to Apollo Epicurius at Phigaleia, and of another in the temple to Apollo at Didyma, seem to him to have been also pointed. The temple to Vesta at Rome affords another instance.

The terms *horn* or *side-arm* are also applied to the portions which project beyond the rest of a piece of framed work, as in the case of the head of a solid door-frame.

The horn shaped leaf so often seen in English mediæval work is profusely used in the west doorway of Huesca cathe-

dral in Spain; in the arches it is generally arranged in the French fashion *à crochet*: it is supposed to date cir. 1350; STREET, *Gothic Arch. in Spain*, 8vo., London, 1865, p. 364.

HORNBEAM, see CARPINUS.

HORNBLENDE. A mineral of a black or dark green colour (these often intermixed), heavier than quartz, but less hard; its specific gravity being between 3.15 and 3.38. It enters largely into the composition and forms part of some kinds of GRANITE and the trap rocks, and appears to constitute a transition between the primary and the volcanic series. When breathed on, it yields a peculiar pungent smell. The constituents of hornblende are—silica, 45.60; magnesia, 18.50; lime, 14; alumina, 1.18; protoxide of iron, 7.50; fluoric acid, 1.50. It generally occurs in masses imperfectly crystallised; but it is very frequently found in laminae, acicular crystals, and fibrous: it will scratch glass, and yield sparks when struck with steel, though with difficulty.

G. R. B.

There are two principal divisions, but they pass into each other: viz. the dark hornblende or ferruginous amphibole above described, and the light tremolite or calcareous amphibole, containing silica 60.7, magnesia 26.8, lime 12.5, with traces of protoxide of iron, fluoric acid, and water, with a specific gravity of 2.93: compact tremolite is also called jade and nephrite.

HORNE (. . .). An Act of Parliament having been obtained June 1739 (12 George II) for building the church of S. Katherine Coleman, Fenchurch-street, London, the names of eight surveyors were received Aug. 1739 by the vestry as those of candidates for making designs: on two per cent. being offered as remuneration, Mr. Cooley accepted it, but Mr. Stibbs declined. In October, Mr. Horne, Mr. Cooley and Mr. Bates attended, and each having agreed to the two per cent., Mr. Horne was elected "surveyor for the purposes in the said Act". The vestry books shew further that Thos. Stibbs and Wm. Cooley took the contract for building the church; extra brickwork was charged at five guineas per rod.

On 14 March 1741 a "committee was appointed to consider of a plan for erecting a hospital on the estate purchased of the earl of Salisbury in Lamb's Conduit-fields, which on 30 June 1742 was approved by the general court, and ordered to be executed under the direction of James Horne, who generously offered to perform the office of their surveyor without any reward whatsoever": the first stone was laid at the south-east corner of the west wing 16 Sept. 1742; UNIVERSAL MAGAZINE, 1751, ix, p. 323. The design has been usually attributed to Jacobsen, one of the governors. The chapel and east wing were built 1747-52. It may be well to note that Henry and Thomas Horne were members of the Tylers and Bricklayers Company in 1700.

HORN OF PLENTY. See CORNUCOPIA.

HORN STONE. A stone described by URE, *Dict. of Arts*, 8vo., Lond., 1846, as being a variety of rhomboidal quartz, which is more commonly known by the name of chert: it is much used for forming millstones with which flints are ground. It has usually a dull and splintery fracture, sometimes conchoidal; it differs from felspar, inasmuch as it is infusible without the addition of an alkali; and occurs massive, and in pseudo-morphous shapes. Its lustre is dull or glimmering, opaque, or translucent upon the edge; sometimes the whole mass, if thin, has the translucence of certain horns, whence the name is derived; the colours are numerous, and they are usually dull, with a marked prevalence of the grey tones. The geological locality of the horn stone is peculiar, as it occurs in masses in the primary, and in the most recent rocks; for instance, it envelops the minerals of the earlier slate rocks, and occurs largely in the tertiary formations of the Paris basin near S. Cloud, and Neuilly; beds of chert also occur in the secondary formations in England, Normandy, Belgium, etc. Horn stone is largely used for the metalling of roads in the localities where it abounds. According to KIRWAN, its composition is, silica, 72; alumina, 22; and carbonate of lime, 6. **CHERT.**

HOROLOGIUM. The name by which the building at Athens, now usually called either the temple to the Winds or the octagon tower of Andronicus Cyrrhestes, is mentioned in VARRO, *R. R.*, iii, 5. Besides serving the purpose of a public clock, the structure indicated the prevailing wind, according to VITRUVIUS, i, 6, who notices that it carried a vane consisting of a bronze figure of a Triton holding a wand in the right hand. The time was exhibited in two manners: externally, by a sun-dial on each face; internally, by a clepsydra or water-clock supplied by the fountain Empedo, which was also called Clepsydra. The date of the erection of this building (given in STUART and REVETT, *Ant. of Athens*, fol., London, 1762, i, 13) probably ranges between the years 325 and 75 B.C.

HORRE. A hard, though coarse, open grained, heavy wood of Ceylon. 71.

HORREUM (Gr. *ἀπείριον*). These words have been frequently translated by 'granary'; but their real signification is rather a place in which the annual fruits of the earth are stored, i. e. a barn, as in COLUMELLA, i, 10. Yet the word clearly means an open shed for ploughs, etc., "horreum quo confertur omne rusticum instrumentum et intra idipsum clausus locus quo ferramenta condantur", as used by COLUMELLA, i, 6; who, xii, 50, appears to mean a fruit-rack by "pensile horreum quo imponantur fructus, idque tabulatum simile esse debet granario." And wherever used by several late authors the term must be translated as magazine or storehouse, in which latter sense PALLADIUS, i, 19, considered it as divided into *granaria*, or receptacles for each sort of grain. It is scarcely necessary to refer to the familiar language of HORACE, *Odes*, iii, 28, who alludes to the *horreum* as a wine cellar; of PLINY, *Ep.*, viii, 18, who speaks of the *horreum* as containing statues; and of SENECA, *Ep.*, 45, who proposes to empty his *horreum* of books.

HORSE. This animal, besides being considered as an attribute of Neptune, appears to have afforded to the ancients an emblem of the human career; at least RAOUL ROCHEFFE, *Tableau des catacombes*, 12mo., Paris, 1853, p. 238, accounts for the representation of the horse in scenes of departure, final farewells, and funeral repasts, as significant of the course of human life, which is understood to have been happily accomplished where the palm-branch also occurs. The action of the animal may be also supposed significant of the calm, progressive, or excited passage of the life commemorated. The horse was adopted by the early Christians as an emblem of the same kind, according to the tablet in memory of Vettia Simplicia, aged 43 years and 6 months, given in LUPI, *Dissertatio—Severæ Martyris*, 4to., Palermo, 1734, p. 58 (whose notes upon the representation thus of the course of life on this and other examples, are extended in his essay, "Sopra i cavalli sovente scolpiti o dipinti negli antichi monumenti Cristiani", in his *Dissertazioni*, 4to., Faenza, 1785, i, 257), the horse, palm-branch, and mason's square in the instance cited, being considered to be inapplicable as types of any occupation followed by a Christian Roman female. It is affirmed by ROBERT, *Cours d'hieroglyphique Chrétienne*, in L'UNIVERSITÉ CATHOLIQUE Journal, 8vo., Paris, 1838, vi, 437, that the horse represented by the Pagans as galloping, intimated the rapidity with which a lifetime passes away: but when represented by the Christians as unbridled and grazing at liberty, it intimated the soul released from its mortal bonds and made free for eternity: yet other authors have seen in the horse and palm-branch merely a suggestion that the person to be commemorated had so run the course of life as to obtain the desired reward. The representation of a lion devouring a horse, which occurs on some Lombard and Merovingian structures, as at Monza, Pisa, and Arles, is accepted by some authors as an emblem of brute force crushing weakness.

HORSE. A term given, as well as TRESSEL, to utensils employed for various purposes, viz.

1. The burnt bricks or burnt earth put at the bottom of

kilns, communicating with the furnace mouths and forming flues for the passage of heat; they are also called *benches*.

2. The hand barrow or strong wooden frame with four handles, also called *block horse* in the eastern counties. This is generally used by masons (Fr. *bar* or *bard*; a small one is called *civière*).

3. A light framework of iron and wood on which harness and saddles are placed to dry after use, and to which has lately been added a small boiler with pipes extending along the framework, to dry them in damp weather.

4. A framework of wood or metal on which linen, etc., is hung to dry in closets or rooms; descriptions of these fittings are given in *Detached Essays*, s. v. Drying Closet.

5. The machine used by glaziers to obtain a standing place outside a window, when mending or cleaning it. An "improved glazier's machine" was described by Howell, at the Royal Scottish Society of Arts 1849, as being secured by a screw underneath to make it steadier; and with a cross bar padded to prevent injury to paint by friction; CIVIL ENGINEER JOURNAL, xii, 187.

6. A square timber framing used in forming excavations for raising the ends of the wheeling planks: it is also called *horsing block*.

7. A block of stone placed near doors or gates on which persons can stand before mounting on a horse; it is also called a *horse block*, and *upping stone*; in Scotland, a *louping on stone*.

8. A framework for laths forming shelving on which are placed drainage pipes and other clay goods to dry before being burnt (Fr. *séchoir*, ANNALES DE LA CONSTRUCTION, ii, pl. 45-6).

HORSE CHESNUT or HIPPOCASTANUM, see *ÆSCULUS*.

HORSED MOLD. The term used by plasterers for the cut outline, with which they run moldings, when it is so large that it requires to be mounted on a frame for strength and ease in working it. A. A.

HORSEFLESH WOOD, see *MANGROVE*.

HORSE POWER. The unit, first introduced by James Watt and since adopted by machine makers, in calculating the force exercised by a steam engine. It is usually reckoned to be equal to the effort required to raise 32,000 lbs. avoirdupois (generally called 33,000) one foot high per minute. The calculated power is, however, always considerably short of the real power exercised on the piston; and the investigations of continental authors go to prove that the actual effort exercised by a horse is not more than half that allowed by Watt. G. R. B.

The best way of applying the force of a horse is in a horizontal direction, that in which a man acts least to advantage. A horse can in general draw no more up a steep hill than three men can carry, that is, from 450 to 750 lbs.; but a strong horse can draw 2000 lbs. up a steep hill which is but short. If the hill be steep he is not more than equal to three men, each of whom would climb up faster with a burden of 100 lbs. weight than a horse that is loaded with 300 lbs. The cases in which horse power is used, is in pugmills for tempering mortar; in raising water by pumps or wheels; and in hoists for raising materials. For effectually using the strength of the animal, the track or diameter of a walk for a horse-mill ought to be at least 25 or 30 ft.; GWILT, *Encyc.*, 1842, p. 397, from YOUNG, *Lectures*, 4to., London, 1807, ii, 167.

BREES, *Glossary*, 1853, s. v., states that a horse loses two-thirds of his effective strength when removed from a 40 ft. track-circle to one of 19 ft.; and that a horse works to the greatest advantage when the line of draught inclines a little upwards to his breast, making a small angle to the horizontal plane. The force of 33,000 lbs. raised 1 ft. high per minute, if continued throughout a day of eight hours, amounts to 150 lbs. conveyed a distance of twenty miles at a speed of two miles and a half per hour. Some engineers consider 125 lbs. a sufficient load for an ordinary horse; but BEVAN calculated that 160 lbs. raised at a velocity of two miles and a half per hour is an average of its power, which also decreases with the

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velocity of speed; thus taking a daily performance at 125 lbs. moved twenty miles a day at a rate of two miles and a half per hour, or 2,500 lbs. conveyed a mile; a stage-coach horse drawing 42 lbs., the rate of travelling being about ten miles an hour at an average of thirteen miles per day at the utmost, the total force exerted by each horse per day would be equal to only 546 lbs. conveyed one mile. Some other details will be found in the memorandum book of Telford, given in the ENGINEER'S, ARCHITECT'S, etc., *Pocket Book*, 1861, p. 29.

SIMMS, *Results of the Application of Horse Power to Raising Water from the Working Shafts at Saltwood Tunnel in 1842*, read at the Institution of Civil Engineers (given in CIVIL ENGINEER JOURNAL, vi, 243-5) found the power of a horse working for

| Hours. | Lbs. |
|--------|--|
| 8 | = 23,412 raised 1 ft. high per minute. |
| 6 | = 24,360 " " |
| 4 | = 37,151 " " |
| 4½ | = 37,058 " " |
| 3 | = 32,243 " " |

32,943 in his work stated below.

Of these results he thought the experiments for six hours and for three hours alone should be adopted; and as a means of comparison he gave the following table, to which additions have been made.

| Name. | Lbs. raised 1 ft. high per minute. | Hours of Work. | Authority. |
|----------------------------------|------------------------------------|----------------|--|
| Boulton and Watt | 33,000 | 6 | ROBINSON, <i>Mech. Phil.</i> , ii, 145. |
| Tredgold - - - | 27,500 | 8 | TREDGOLD, <i>Railroads</i> , etc., 69. |
| Desaguliers - - | 44,000 | 5 | GREGORY, <i>Mathematics for Practical Men</i> , 183. |
| Ditto - - - | 27,500 | not stated | |
| (Emerson - - - | 44,000 | — | |
| Sauveur - - - | 34,020 | 5 | |
| Moore, for Society of Arts, etc. | 21,120 | not stated | (22,016) |
| Smeaton - - - | 22,000 | — | CIVIL ENGINEER JOURNAL, vi, 245. |
| (Reunier - - - | 22,000 | — | |

This table is also given in SIMMS, *Tunnelling*, 4to., London, 1844, p. 71, altering TREDGOLD to 27,000.

Wagoners have stated that good horses would walk at the rate of two miles and a half per hour for twelve hours out of the twenty-four, making thirty miles a day, and each horse drawing one ton would do this for many years. A horse, worked for ten hours a day and well fed, will not have lost much of its value after a few years work (say four or five years?), and would not be so often ill during its work as one worked harder. ROAD.

HORSE RUN. A lift worked by a horse moving backwards and forwards, instead of in a circular path as in a horse gyn; the path or run is longer or shorter, according to the distance to be travelled by the load in ascending or descending, which is generally placed on an inclined plane; but it is rarely used if it be required less than 20 feet. The weight that a horse can thus raise is rarely more than about 10 cwt. The load consists sometimes of a loaded wheelbarrow, guided up the planking of the lift by a man holding the handles; in descending the friction of the tackle offers sufficient resistance to let him down the plank with safety. G. R. B.

HORSESHOE ARCH (Sp. *arco en forma de herradura*; Fr. *arc en fer à cheval*; Ger. *hufeisenbogen*). A stilted arch whose curvature is prolonged below the horizontal line of the centre or centres from which the curve is struck. In the interior of the Pantheon at Rome, as shown by TAYLOR and CRESY, *Arch. Ant.*, fol., Lond., 1821, i, 57, pl. 53, the architrave of the great arch over the doorway is carried down to the principal entablature, without any stoppage of the curve at the level of its centre, and thus slightly takes the horseshoe form. This form of arch has been generally regarded as a Mahometan invention, but it is shewn in the doorway of a rock-cut tomb at Urgub, by TEXTIER, *Descr. de l'Asie Mineure*, fol., Paris, 1839-49, ii, 84, who supposes that it must have been executed in the fifth or sixth century, and refers for other examples to LABORDE, *Voyage en*

Orient (Asie Mineure), fol., Paris, 1838-62, probably alluding to the illustrations therein given, pl. 86-7, from Madenschers, and to pl. 89 which intimates that the church at Aladja has elliptical horseshoe arches. The cathedral at Ani, commenced 1010, and finished before 1060, is given by *TEXIER, L'Arménie*, fol., Paris, 1842, i, 98, pl. 18-20, who remarks the simultaneous employment there of the pointed arch formed by segments of circles, and of the surmounted horseshoe arch, whereas these features are rarely found together in other Christian structures; another such case would seem to occur in the example from the triforium of the church of the Abbaye aux Hommes at Caen as figured No. 9 in the plate I of "Arches" in *BRITTON, Arch. Dict.*, 8vo., London, 1838, who, however, in a larger illustration contained in the *Arch. Ant. of Normandy*, 4to., London, 1828, pl. 6, had already so clearly shown them as merely stilted, that careless drawing must be imputed to the later work; and may have caused the appearance of a horseshoe arch in his example No. 3, from the crypt of the cathedral at Canterbury; while his example from Winchester, viz., No. 4 of plate 1; and from Peterborough, viz., No. 9 of plate 2, are drawn as simply stilted, although mentioned at p. 43 as horseshoes. The church at Dighour, dated 1164 and 1242, offers a remarkable instance of the employment of horseshoe arches which more markedly pass their centre than those at Ani, according to *TEXIER, L'Arménie*, pl. 27-8, who notices, p. 114-20, that the horseshoe arch, although usually regarded as Saracenic, is so rare in the west that its eastern origin cannot be denied; that this arch seems certainly to have been introduced into Europe by the Moors, but appears in oriental buildings before the period of the Hegira; that students have long been taught that this sort of arch was in its origin exclusively used by Mahometan artists, whereas its employment in Armenia at a period when that country was exclusively Christian, leads to the inference that the form is due to the Christians rather than to the Mahometans; that the Arab architects have adopted it, and in some countries have used it almost exclusively; that it was most employed under the Ommiyade dynasty; that it may be seen in a great number of Arabian buildings in Spain; and that it is perpetuated to the present day in Algeria (whereas at Algiers it is hardly to be seen, though it predominates in Tunis).

The same author, *Asie Mineure*, ii, 73, pl. 86, attributes the mosque of Houen at Casarea with its pointed horseshoe arch to the last half of the twelfth century. The name *arc à plein cintre outre passé* is employed to designate the horseshoe arch by *GIRAULT DE PRANGEY, Essai*, 8vo., Paris, 1841, who, p. 35, while noticing its occurrence so early as 786-793 in the mosque at Cordova, also admits that this form seems to have been derived by the Arabs from the Byzantines; and in his text to pl. 24 gives the date 1376, for the pointed horseshoe which there appears. The horseshoe arch in the chaitya cave No. 19, at Ajunta, dating probably in the fourth or rather sixth century, and those at Karli, perhaps so much older as B.C. 163, are given in *FERGUSON, Rockcut Temples*, fol., London, 1845, pl. 6 and 10. The remarkable horseshoe arch at the monument called Takht i Ghero, near Holwan or Serpoul, is shown in *FLANDIN and COSTE, Voyage in Perse*, fol., Paris, 1844-50, pl. 214-5, p. 172, and is described in their *Relation*, 8vo., i, 465.

A. P., in the *BUILDER Journal*, xvii, 444, states that he was uncertain of the origin of the horseshoe arch, etc., and concludes that the form is constructionally bad: "I have been for some considerable time past of opinion that the use of the horseshoe arch arose out of good construction, and have made several experiments with ribs of that form, both of wood and iron, on a limited scale, and find that with a rib containing from 230 to 240 degrees of a circle, with depth of section of a rib equal to a quarter of a circle to each foot of span of arch, the ends of the ribs being placed on upright pieces of timber, representing walls, the ribs loaded with weights greater in pro-

portion to the span than roofs are usually required to carry—no lateral strain or thrust takes place, either outwardly or inwardly; but that, by the sweep of the curve being prolonged down below the line of the semicircle, it has the effect of neutralising the outward thrust of the rib at that line. May not this have been the origin of that form of arch in good construction of timber, and afterwards copied in stone of bad construction?—Their strength might also be improved by principal rafters springing out of the curved ribs, and meeting at the apex in a metal saddlebox, with an iron bolt let down through the same, and properly fixed to the crown of the rib, and struts being fixed from these to support the principal rafter between the apex and the springing from the rib, thus making the crown of the rib the strongest part of the roof, instead of its frequently being the weakest."

HORSESHOE PLAN (*Fr. fer à cheval*). The name given in buildings or gardens to any piece of construction or of design which has something like a horseshoe for its plan, such as the ancient theatres, or as the circular terraces in the garden of the Tuileries near the place de la Concorde, and as the terrace of the parterre de Latone at Versailles. The shape now generally used for the auditorium of a theatre, seems to have been first adopted in the cases of the theatre of S. Carlo at Naples, and of the great theatre by Alfieri at Turin.

HORSE TIES. The name formerly given to large iron cramps used for binding masonry, but now usually called dog ties. These ties, called "*grossis cavillis ferreis cu' capitib' stagnimatis*," had probably the heads timed to prevent oxidation, in repairing the "little hall" at Westminster, temp. Edw. II., 1307-10, as noticed by *BRAYLEY and BRITTON, Palace of Westminster*, etc., 8vo., London, 1836, p. 113, "the upper masonry was bound together with large iron ties, on account of the great weight and size of the timbers." In the queen's hall, repaired at the same time, it is noticed the cramps were not of iron.

HORSHAM SLATE AND STONE. A member of the Wealden formation, consisting of a calcareous sandstone, quarried in considerable quantities, and raised of great thickness, for local use in some parts of Sussex (around Horsham) for farm and cottage buildings. It is tolerably regular in its dimensions, but its very great weight and the facility with which it decomposes on exposure to the weather, will always constitute an objection to its general use for roof covering whenever slate can be obtained at a reasonable price. The partings of the strata are often ripple marked, and many freshwater fossils are contained in it.

G. R. B.

Used as slate it was laid (cir. 1700-36) of different sizes, from 8 or 9 ins. to 24 ins. or more in length and breadth, and commonly from half an inch to an inch thick. A load would cover about three-quarters of a square: the slabs were pointed, that is, the lower ends were struck with mortar. The weight of a square was from 33 to 34 cwt., about double that of tiling; it was also somewhat dearer; and although the timbers had to be made proportionately stronger, a recompence was found in its lasting longer than tiles.

4.

Sometimes the beds of the Horsham stone increase so much in thickness that they are worth quarrying for building stone, the composition of which is such that it can be employed in the masonry of good buildings in places above the reach of damp. All this stone is, however, of a very perishable nature; and it yields easily to the attacks of moisture, without its being at all necessary that the latter should contain any particular element of decomposition. The quarries of the neighbourhood of Horsham are nearly horizontal, for a large space, so that they are difficult to work, because of the surface waters. Owing to the very uncertain durability of this stone, it is never used out of the locality where it is raised.

G. R. B.

HORWOD (WILLIAM) 'freemason' of Fotheringay, Northamptonshire, covenanted 1435, "by oversight of masters of the same craft," and under a clerk of the works, to build the nave

and ailes, and spire of the chapel of the college in that town, for £300, which if not performed duly "he shall yield his body to prison at the lord's will." The contract is given in DUGDALE, *Mon.*, fol., London, 1830, vi, p. 1414; and with illustrations, by the OXFORD ARCHITECTURAL SOCIETY, 8vo., Oxford, 1841.

HOSKING (WILLIAM), (formerly F.R.I.B.A. and F.S.A.), was born 1800, at Buckfastleigh, Devonshire. Whilst quite young he was taken to New South Wales, where he was apprenticed to a builder and surveyor. Returning 1819 to England, he was articled for three years to W. Jenkins of Red Lion-square; after which he travelled for about a year in Italy and Sicily. In 1834 he was appointed engineer to the Birmingham, Bristol, and Thames Junction railway, afterwards known as the West London railway, and designed for it 1838-9 the arrangement near Kensal-green, by which the Paddington canal is carried over the railway, and a public road over the canal; a mode of construction much followed since in this country and abroad. The alteration of the structure in 1860 caused him some annoyance. (It is given in *ALLGEMEINE BAUZEITUNG*, fol., Vienna, 1838, pl. 211, p. 205; in BLOUET, *L'Art de Bâtir*, fol., Paris, 1847-8, pl. 97; and in SIMMS, *Public Works of Great Britain*, fol., London, 1838. In 1840 he was appointed professor of the 'art of construction,' and 1841 of the 'principles and practice of architecture,' at King's college, London, which post he held until his death. In 1844, on the passing of the metropolitan building act, he was appointed one of the official referees, and retained office until the act of 1855, when he retired with his colleagues A. Poynter and J. Shaw, each on two-thirds of the salaries.

His executed works consist of Knightsbridge market; Trinity chapel at Poplar for Mr. Green (given in *COMPANION TO THE ALMANAC*, 1842), the windows in the roof not being seen from the outside; Abney Park cemetery, Stoke Newington; and a pile of buildings on the south side of New Cannon-street, London, for Messrs. Behrens and Co. He was associated with John Britton in the restoration of S. Mary Redcliffe church, Bristol; on which they published *Abstract of Reports*, 4to., Bristol, 1842: he resigned shortly afterwards, and was succeeded by G. Godwin. In 1844 he exhibited a design for "remodelling the superstructure of Westminster bridge upon the present piers." He published with JENKINS, *Selection of Architectural and other Ornaments, Greek, Roman, and Italian*, fol., London, 1827; in 1830 he wrote *Architectural sculptural remains at Pestum, and on the reference the latter may bear to the mythological history of that city*, given in the *ARCHÆOLOGIA*, xxiii, 85; and having delivered in January 1829 a course of six lectures at the Western Literary Institution, noticed in the *ATHENÆUM Journal*, 1829, p. 41, 157, he was employed to write the treatises on *Architecture, Building, Masonry, Joinery, and Carpentry*, for the sixth edition of the *ENCYCLOPEDIA BRITANNICA*, 1832; these were afterwards published separately, and again in 1860 with very few additions. He published *Introductory lecture at King's College*, 8vo., London, 1841; *Introductory lecture on Architecture, with some remarks on Competition*, 8vo., London, 1842 (*CIVIL ENGINEER Journal*, v, 91, 411); *Essay on the Construction of Bridges*, published with others, by Weale, 8vo., London, 1843; lectured at the Institution of Civil Engineers *On the Introduction of Constructions to retain the sides of deep cuttings in clays or other uncertain soils* (given with woodcuts in *CIVIL ENGINEER Journal*, viii, 209-13); wrote *Healthy Homes; a Guide to the proper regulations of Buildings, Streets, Drains, and Sewers*, 8vo., London, 1848; new edit. 1849; and *Observations upon the recent addition of a Reading room at the British Museum*, fol., London, 1858, wherein he claimed to have been the first to suggest the erection in the centre, of a building on so magnificent a scale, as first illustrated in the *BUILDER Journal*, 22 June 1850. He died 2 August 1861, aged 61 years, and was buried at Highgate cemetery. *BUILDER Journal*, xix, 560, 784.

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HOSPES. Among some stones at Cajazzo, near Naples, was found the inscription, "M. Herennius M. F. Gallus R. Vese-rius Q. F. Duo Vir D.D.S.F.C. Quinq. Eidemq. Prob. Arci-tectus Hospes Appiai. Ser.," which appears to date in the last century of the republic. MOMMSEN, *Inscriptiones Regni Na-politani Latine*, 4to., Leipzig, 1852, p. 204, No. 3918. 117.

HOSPICE. This term as derived from the Lat. *hospitium* means properly neither an almshouse nor an hospital, but a rest for travellers, where a religious fraternity afforded, either gratuitously or otherwise, hospitality to strangers whether pilgrims or travellers, as is the case in the present day at the hospice du Mont S. Bernard. It also was applied to a small house for the reception of the travelling members of the religious order to which the building belonged. In later times it became a distinguishing name for the structure which was prepared in a town, by monks or nuns, as a refuge to which they could retire from their establishments in the open country during any period of warfare. Consequently the modern use of the word *hospice* for an almshouse or an hospital is a mis-application of the term: yet it has become so prevalent, that its use in these senses cannot be disregarded, especially as it is not always to be translated by the word 'asylum'. TURNER and PARKER, *Domestic Architecture*, 8vo., Oxford, 1851-9; DOLLMAN, *Ancient Dom. Arch.*, 4to., London, 1858.

HUSSON, *Étude sur les hôpitaux*, 4to., Paris, 1862, p. 277-81 (a valuable publication), expresses himself in the following terms: "Hospices et maisons de retraite—différant essentiellement des hôpitaux, quant à leur destination, et variant également entre eux suivant la condition des individus qui y sont recueillis—ouvert à tous les indigents de la ville, que l'âge ou des infirmités prématurées reconnues incurables, mettent dans l'impossibilité de pourvoir à leur existence; l'hospice est le complément indispensable de l'hôpital": and "en Angleterre, l'hospice se confondant généralement avec l'hôpital, en tant qu'il se distingue du *workhouse*, le même établissement accueille indistinctement les affections et les infirmités les plus diverses, et se borne à les répartir dans des quartiers séparés." He adds that "cet usage existe également dans la plupart de nos villes de province; nombre d'administrations hospitalières, dont les ressources sont trop limitées pour entretenir plusieurs établissements, réunissent, dans une construction mixte, l'hôpital et l'hospice, et quelquefois même y joignent encore l'asile d'aliénés." His distinction between them is best seen in his statement that "les hospices proprement dits sont—La Vieillesse-femmes (Salpêtrière), La Vieillesse-hommes (Bicêtre), Les Incurables-femmes, Les Incurables-hommes, et Les Enfants-assistés; les hospices fondés—La Reconnaissance, Devillas, et S. Michel; les maisons de retraite—Les Ménages, Rochefoucauld, et Ste. Péline." His descriptions of these are accompanied by plans, viz., the first, p. 284, the bâtimens Mazarin and Lassay 1756, and pl. 6; the second, pl. 7; the fourth, in the rue de Sèvres, p. 31 and 303; the sixth, at Garches, pl. 8; the seventh, at Issy, p. 317; the eighth (fondation Boulard), at S. Mandé 1826-30 by Destailleurs, p. 319; the ninth, at Issy 1860-63, pl. 9; and the eleventh, at Auteuil 1860-62, by Ponthieu, pl. 10. It is desirable to state that admission to each of these 'maisons de retraite' is obtained by payment: Les Ménages is for the reception of married or widowed persons bringing their own furniture, at a payment of £64; the Rochefoucauld and Ste. Péline are for government servants or persons of either sex not being absolutely paupers, at a payment of about £180 to £30. The same author gives the hôpital-hospice at Gisors 1860 by Questel, which he describes as hospital, almshouses, orphan asylum, and lunatic asylum; pl. 15 the hôpital-hospice or asylum for incurables, proposed by T. H. Wyatt as part of a large design for the island of Malta, and now (1865) the subject of contract for erection; (other portions are given in NIGHTINGALE, *Notes on Hospitals*, 8vo., London, 1863); and pl. 8 the hospice de la Reconnaissance (fondation Brezin) at Petit L'Étang, frequently called Garches, built 1836 on the

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plan of J. F. Delannoy by M. P. Gauthier, near S. Cloud. The two last subjects are also to be found in the *Illustrations*, 1868-4-5.

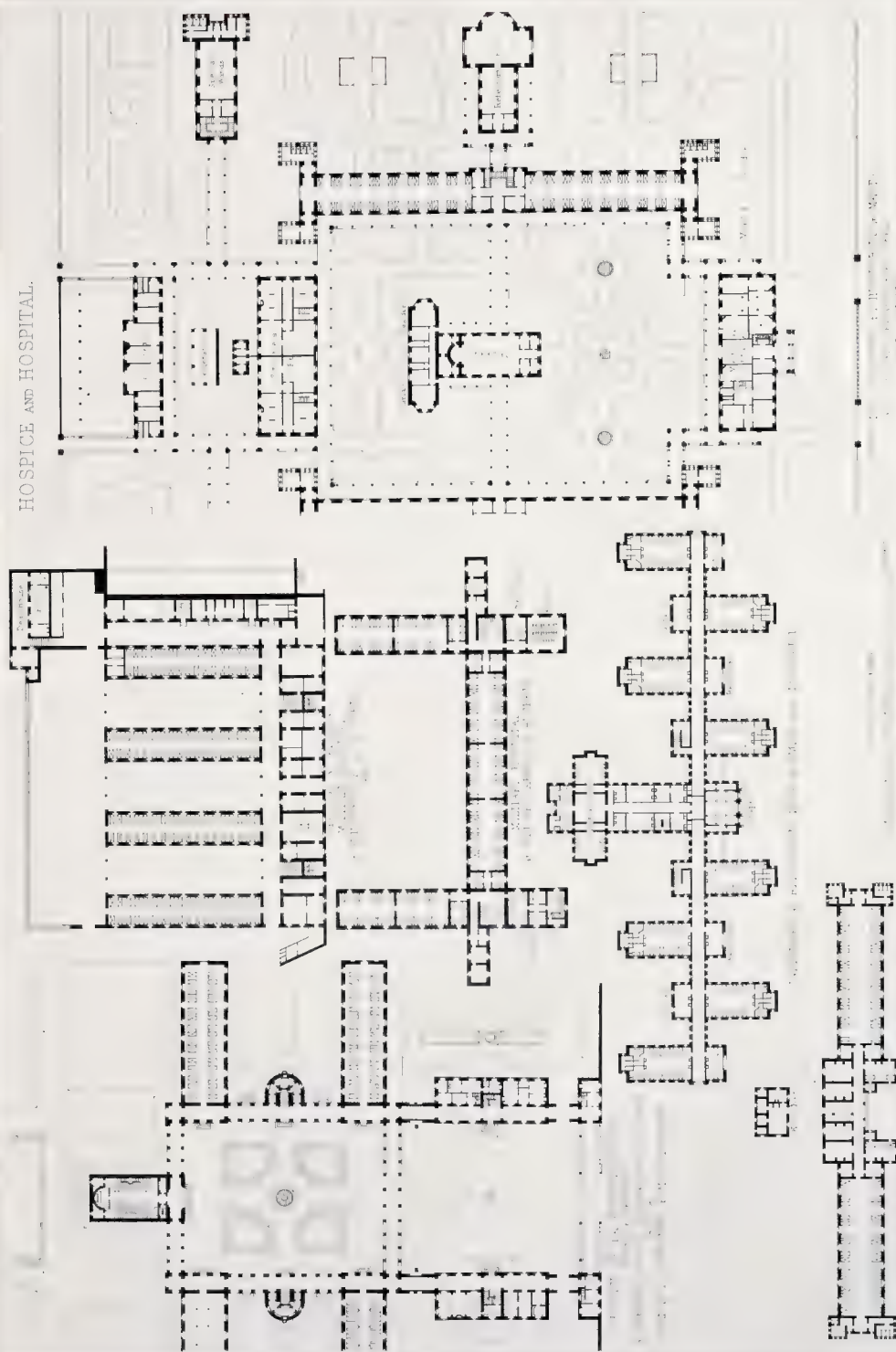
HOSPITAL. The general name for a building for the reception of travellers (CARAVANSERAI, HOSPICE, HOSTEL, KHAN, MORISTAN, OKEL); the temporary accommodation of the destitute (HOME, REFUGE); the support of meritorious and indigent persons (ALMSHOUSE, ASYLUM, BEDEHOUSE, COLLEGE, POORHOUSE, WORKHOUSE); the maintenance and education of youth (ASYLUM, COLLEGE, SCHOOL); or the care of the sick. Although this last class alone will be treated as the subject of this article, it must be remarked that sometimes the intentions of the founders of hospitals have been altered. Thus the hôtel-dieu at Paris, originally a resting place, has been appropriated (before 1200 it is stated) to the sick: the priory of Knights Templars at Kilmainham had until 1312-5 an almshouse and hospital for the sick, which, on falling into the possession of the Hospitalers, were used for the reception of guests and strangers to the exclusion of the sick and infirm; and great part of the monasteries may be said to have originally been almshouses, but they have become (like the hospice du Mont S. Bernard) resting places on a large scale; whether the relief be gratuitous, or acknowledged by donations, or even purchased as if at an hostel, as in this last case. It must further be observed, that sometimes the intentions of the founders included two or more of the classes above named. Thus the hospital of S. Cross near Winchester was a rest but also an almshouse: the ospedale di Pammatone, erected 1420-3 at Genoa (GAUTHIER, *Les plus beaux édifices*, fol., Paris, 1818, pl. 52-7), and the hospice des Quinze-Vingts at Paris, were of mixed character, being respectively asylums for the incurable and the blind; the ospedale di S. Spirito in Sassia rebuilt 1471 and later, at Rome (plan given in LETAROUILLY, *Les édifices de Rome Moderne*, fol., Paris, 1840, pl. 256) supported 1,680 sick persons, with 800 foundlings and 500 lunatics: the Bogodolnia at S. Petersburg (much on the scale and plan of the Bicêtre, formerly for malefactors; and the Salpêtrière, formerly for prostitutes, foundlings, and lunatics at Paris) accommodated 1,400 persons, being either incurables, octogenarians, or widows: the hôtel-Dieu built 1443 for nuns poor, and sick, at BEAUNE (given in VERDIER and CATTOIS, *Architecture civile et domestique*, 4to., Paris, 1855, i, 1) is cited by VIOLETTÉ LE DUC, *s. v.*, as a complete model of such an establishment at that period, except that a flat ceiling has been given to the great hall: and the conjunction of almshouse with school, as the hospital at Ewelme (shewn in DOLLMAN, *Examples of Ancient Domestic Architecture*, 4to., London, 1858), or as Whitgift's hospital at Croydon, is one of those happy combinations which, though not unfrequent, are not sufficiently common: also, Bridewell, given by king Edward VI as the first workhouse, or rather house of correction, for strumpets and idle persons, and for the lodging of poor wayfaring people, was long regarded as an hospital rather than a prison, and drew vagabonds to the metropolis: it was afterwards used as a prison for persons summarily convicted within the City of London; and is now a school for the industrial education of poor neglected children. The popular use of 'hospital' for the classes of establishments above mentioned, has been the cause of great confusion, as may be seen in TURNER and PARKER, *Account of Domestic Architecture*, 8vo., Oxford, 1851-9, ii, 194; iii, 45, 179. LAZAR HOUSE; LAZARETTO; LUNATIC ASYLUM; MALADRERIE.

The sick persons who hoped to profit by the worship of Æsculapius and by the help to be derived from his priests (the oath taken by these advisers before receiving possession of the medical secrets of their fraternity is still extant) must have had for shelter near his temple some buildings (EPIDAUROS, HIERUM), which have been compared to hospitals for the temporary reception and treatment of patients: it is unnecessary to enter into the merits of the restoration proposed by PIRANESI

of the island in the Tiber at Rome; for upon the testimony of S. JEROME, *Ep.*, lxxiii, there does not appear to have been anything corresponding to a modern establishment of that character before 380 A.D., when Fabiola took charge of sick paupers who had been accustomed to lie in the streets and squares. It is true that this statement seems at first sight to be at variance with the direction of COLUMELLA, *R. R.*, xi, 1, and xii, 3, 'in valetudinarium deducat', but this applies to a servant to be taken into the domestic sick-room. It is even not evident that the Romans had military hospitals, although there must have been places reserved during their campaigns for the sick and wounded, both men and beasts; that the *valetudinarium* is mentioned by HYGINUS GROMATICUS, *De Castrametatione*, is noticed by PRINGLE, *Observations*, 8vo., London, 1775. The very words brephotropeum, gerontocomeum, nosocomium, orphanotropeum, ptichotropeum, and xenodochium, suggest the language of a Christian people: but Irish writers insist that, before the introduction of Christianity into their island, the 'brian bearg' or 'house of sorrow', attached to the royal residence at Emania, was a building set apart for the maintenance and recovery of the sick and wounded. The question of early hospitals for the sick is discussed in NOTES AND QUERIES *Journal*, 1865, 3 ser., vii, pp. 13, 176. The hospital of S. Bartholomew at Smithfield was founded for the entertainment of poor diseased persons until their recovery, of women in childbirth, and of the orphans (until seven years old) of mothers who died in the house; which was governed by a master, brethren, and sisters: this appears to be the most precise account that has been preserved of a real hospital in early times: and it may be noticed that the practice of medicine was not prohibited to the occupants of monastic establishments until the middle of the twelfth century.

In speaking of mediæval hospitals, great difficulty arises from the careless use by French writers of the terms *hospice*, *hôpital*, *hôtel-Dieu*, and *maladrerie*. The necessity for distinguishing between the three latter words is asserted by LEBEUR, *Histoire de la ville de Paris*, 8vo., Paris, 1754, i, 25-6, who considers the *hôpital* as a rest, and treats the two last as meaning an hospital for the sick: TENON, *xiv*, says "hôpital ou maison de charité", and xlii, "hospice ou petit hôpital"; in general the words *hôpital* and *hospice* are applied indifferently, as in APPERT, *Rapport*, 12mo., Paris, 1824: but the most recent authorities define *hôpital* as formerly a rest but now a hospital; *hospice* as properly a rest but now an asylum; and *hôtel-Dieu* or *hôpital-général* as the principal hospital for the sick and poor of a town; while VIOLETTÉ LE DUC, *Dict.*, *s. v.* Hôtel-Dieu, p. 117, notices that the *maladrerie* was for persons afflicted with contagious diseases. Yet, while particular attention is bestowed by the last named author upon the building noticed below at Tonnerre, he gives illustrations from VERDIER, ii, 101-3, of such hospitals for the sick as the hôtel-Dieu at Angers (1153-84); and the infirmary in the abbey at Ourcamp. From these writers may be collected illustrations or notices of edifices being three-ailed halls, at Chartres, and at the abbey of S. Jean des Vignes at Soissons; at Orleans (destroyed), at Brie-Comte-Robert, and at Compiègne, being two-ailed halls; and at Lubeck and at Bourges, being single halls; which, though supposed to have been intended for the reception of the sick, may have been simply asylums or rests. They should be compared with the 'bede-houses' or asylums at Stamford and at Higham Ferrers, as given by DOLLMAN, who also shows as an almshouse S. Mary's hospital at Chichester, probably originally a rest for nuns, if not a convent, all having in their plan the same principle, viz. a hall ending in a chapel: the building at Tonnerre, which VERDIER, i, 14, says was for the sick, but states, ii, 148, that it was for the poor, was originally intended as a rest, as is shewn by DORMOIS, *Notes*, Auxerre, 1853, but it is given as an example of an hospital by VIOLETTÉ LE DUC. This author, without pretending that the quasi-cellular system evidenced in some of the buildings just named is otherwise preferable to the

HOSPICE AND HOSPITAL.





system of open wards, insists that it is morally superior in the privacy which it gives to each patient, who may thus be spared the sight, though not the sound, of another's agony; as well as that irritation justly reprobated by NIGHTINGALE, *Notes on Nursing*, 8vo., London, 1860.

With regard to modern hospitals, it may be noticed for the sake of comparison of plan, that the following list includes the INFIRMARY or hospital for the alleviation of incurable diseases (although that, as previously stated, is rather an almshouse). A Lock hospital derives its name from *logues* or locks of hair, lint, or rags applied to sores; a *loke* or lock formerly signified a lazaret, and the word now denotes an hospital for the special treatment of patients suffering under the venereal disease, according to the PICTORIAL HANDBOOK OF LONDON, 1851, which gives the names and dates of erection of the London hospitals and infirmaries at that time. With respect to specimens of the continental hospitals, it may be noticed that the CONSEIL GÉNÉRAL D'ADMINISTRATION DES HÔPITAUX ET HOSPICES CIVILS DE LA VILLE DE PARIS, *Plans*, fol., Paris, 1820, gives twenty-nine plates of the hospitals then existing; and its successor the Administration générale de l'assistance publique à Paris, has published two works of considerable importance, viz. BLONDEL and SER, *Rapport sur les hôpitaux civils de la ville de Londres au point de vue de la comparaison de ces établissements avec les hôpitaux de la ville de Paris*, 4to., Paris, 1862; and HUSSON, *Étude sur les hôpitaux*, 4to., Paris, 1862.

In London, Guy's hospital (1720-4) and the London hospital (1740) may be taken as specimens of the mode of planning at those periods; and with them seems to have commenced in the United Kingdom the passion for erecting hospitals, which in Dublin produced on an average a new one every ten years. There seems to have been little hesitation either in Great Britain or in Ireland as to the merits of any design until the commencement of the present century; thus WARBURTON, *History of the City of Dublin*, 4to., London, 1818, ii, 701, describing Sir Patrick Dun's hospital, commenced 1803 in that city, notices the fever ward 66 ft. by 38 ft. and 20 ft. high, with partitions 7 ft. 6 ins. high (forming cells on the medieval system advocated by VIOLETT LE DUC) and mentions that the plan was adopted in consequence of recommendations in HOWARD, *Account of the Principal Lazarettos*, 4to., Warington, 1789, and of observations which proved that in the best regulated hospitals, with wards of the ordinary height (from 11 to 13 ft.), infectious diseases were propagated, notwithstanding every attention paid to ventilation and cleanliness. The same historian, p. 710, shows that at the erection 1804 of the fever hospital, double-bedded rooms 16 ft. by 11 ft. 3 ins. and 10 ft. 6 ins. high, ranged along galleries, were preferred by medical authorities as affording privacy, separation, ventilation, avoidance of disturbance, and secrecy of death, with facility of cleansing and fumigation, to open wards which had the recommendation of general ventilation, smaller surface of walls for the deposit of foul matter, and positive cheapness: he describes at some length the mode adopted for ventilation.

Although DURAND, *Précis*, 4to., Paris, 1821, p. 67, had indicated, in a passage which will presently be quoted, the plan from which the model buildings of the present day have been developed, the state of medical science in England as regards plans for hospitals, until a recent period, seems to be indicated in GRANVILLE, *Guide to St. Petersburg*, 8vo., London, 1835, ii, 270-91, who described the military general hospital and the artillery hospital, and considered that the regimental hospitals in that city, for style of building, order, cleanliness, and internal arrangement, superior to anything he had seen elsewhere (except the hospital for the poor in the same city), even to the naval hospitals at Haslar and at Plymouth. The same writer criticized the civil hospitals, particularly the Obouchoff, having beds for 500 patients and 120 lunatics, in wards 560 ft. long by 40 ft. wide; but praised the Bolnitza dlia Bednikh, or

imperial hospital for 240 sick paupers, as being arranged better than any others, with rooms for twelve to fifteen beds on each side of a long corridor. The ALLGEMEINE BAUZEITUNG, 1851, xvi, 16, considered that a new era in the erection of hospitals began with the erection 1787 of that at Bamberg; the great feature being the abolition of night stools in favour of a closet having an entrance from the ward and an exit into the corridor; and mentions the Israelitenspital (1793) at Vienna, the Allgemeine krankenhaus (1823) at Hamburg, and the Katharinen hospital (1827) at Stuttgart, as models; it gives a plan of the S. Annen-kinderspital (1848) at Vienna, on the system which GRANVILLE had praised.

Such were the principal hospitals out of France (including the improvements effected 1848-9 at Middlesex hospital), although GWILL, *Encyclopædia*, 8vo., London, 1842, had called attention to the plans published by DURAND. The latter, remarking that of all buildings an hospital requires most salubrity, and usually possesses the least, observed that wards, united at the angles of a square or at the centre of a cross, form centres of infection to the patients and to the inhabitants of the neighbourhood. The buildings at Milan and at Plymouth are each only deserving of praise for a single point; the first, for the pleasant and convenient promenades supplied by the *loggie* to convalescents; the second, for being the best arranged of all hospitals, in having fifteen pavilions united by colonnades around a spacious court; but this praise is moderated because the wards are coupled. He concludes by remarking that the hospitals of La Roquette and of Ste. Anne outside Paris, designed upon a programme devised 12 March 1788 by the Académie Royale des Sciences commenced 1788 by Poyet, but almost immediately abandoned, would have been models. Each ward was to be 32 ft. 9 ins. wide and 29 ft. 6 ins. high, with a passage 39 ins. wide behind the beds, the night stools being in the window seats, and the water closets at the end of this passage, which was to be 6 ft. 6 ins. high under the windows. Each ward was to have a brick vault, with openings in the centre, a system adopted in the ospedale di Pammatoe at Genoa long previously. The influence exercised by Poyet's designs, upon all such edifices that have been since executed in France, is noticed in the BUILDER Journal, 1856, xiv, 509; which, mentioning the merits of the hospital erected 1854 by Drossaert at Malines (engraved in the *Journal Belge de l'Architecture*, year vii) notices that the hôpital du Nord, afterwards Lariboisière at Paris, for 606 beds, erected 1846-54 by GAUTHIER, at a cost (including site) of about £650 per bed, followed the arrangements of the new hôpital St. André, erected 1825-9 at Bordeaux by J. Burguet for 728 patients, at a cost of £56,318, and gives Burguet's plan. This plan appears to have been adopted as a model by ROBERTON, who in two papers read at the Statistical Society of Manchester, established a distinction between dormitories for the healthy and wards for the sick, contending for an abolition of all that communication by passages and stairs between wards, which he considered to create an "hospital atmosphere". He supposed that the prevention of the formation of such an atmosphere had been secured on the continent in several instances, naming the hôpital de S. Jean at Brussels, and the hôpital Beaujon, with the hôpital Lariboisière at Paris.

The recommendations made by ROBERTON as to site, contents, arrangement of windows, natural ventilation, allowance of 2,000 cubic feet to each patient, heating, and disposition of beds, which are given in the BUILDER Journal, xiv, 509, provoked a criticism, p. 526, in favour of artificial ventilation with an ascending current, which was answered, p. 531, by a plea for artificial ventilation with a descending current, giving an account of the quantity of cubic feet per patient admitted in a minute; at the hôpital Lariboisière 12 to 14 ft.; at the hôpital Beaujon 24 to 36 ft., which was inefficient; and at Guy's hospital 40 to 60 ft., which was successful. This was criticised in a rejoinder giving an account of satisfactory ventilation attained

1849 at Middlesex hospital, acknowledged p. 662, and continued xv, 36. This literary vigour appears to have been occasioned by the publication (1856) of the plan by Mennie for the Victoria general military hospital for 1000 men at Netley. Although the hospital at Netley has been pronounced an error, care was taken at first by the English government, which appears to have followed in 1855-6 the example set by the French in 1785, and ordered the construction of a programme. The subsequent difficulties seem to have arisen from the determination to have an average of only ten patients in each ward; Dr. Andrew Smith, director-general of the army medical department, with several military surgeons and officers, being opposed to the adoption of larger wards, although aware that in France the wards contain thirty to forty patients: and the committee (Colonel O'Brien, Dr. Mapleton, and Captain Laffan) decided in favour of small wards. But 2 March 1857 the medical men connected with the Middlesex hospital set forth a memorial which caused an explanation, a reply, an investigation in which the committee obtained from medical officers of the great hospitals in London a general adhesion to the original programme, confidential official communications, a fresh inquiry 1858 with several reports condemnatory of the building, and an approval by Miss Nightingale of the plan as finally amended by its authors. The design is said to have provided averages of 1,315, 1,406, and 1,800 cubic ft. per patient (a list of the space in other buildings, varying from 1,000 to 2,426 cubic ft., is given in the *BUILDING NEWS*, 1861, vii, 939), and to have been commenced upon an estimate of £150,000, increased in three years to £327,919: *BUILDER Journal*, 1856, xiv, 457; xv, 141, 340, 587; xvi, 493; xvii, 603; *BUILDING NEWS Journal*, 1857, iii, 845, 875; iv, 814; v, 945. The communication of the wards with a general corridor and with the water closets has been alleged as its chief fault: but its plan should be compared with others regarded as models at the time, before it be deemed that too high a price was paid for the instruction and correction of the military authorities; or that the whole matter exhibits a remarkable instance of official incapacity.

The amount of experience that had been thus gained was illustrated by the publication in the *BUILDER Journal*, 1860, xviii, 606, of a plan for a regimental hospital with ninety-two beds upon one floor, by Dr. Combe, who assumed that a tenth of the force is liable to be in hospital at the same time, and considered that in civil and naval hospitals one attendant is required for every seven patients, while in military hospitals the attendant can take charge of fourteen. He devised wards 100 ft. long and 22 ft. wide, by 15 ft. high, for twenty-eight patients, giving to each 1178 cubic ft. under the regulations issued by the war office prescribing 1200 ft.; and observed that 2000 ft. are required when the windows are opened once in a day. He cited the opinion of the Commission on Warming and Ventilation, that no reliance for ventilation is to be placed on the fire-grate; considered the questions of small wards, windows, ventilation, water closets and fires; and objected to the Melville hospital at Chatham, the marine hospital at Woolwich, the hospital at Dundee, and at Vincennes, and the hôpital Lariboisière: a criticism and a rejoinder appeared pp. 649 and 684. But this had been preceded by various suggestions, mainly valuable, that had appeared in the periodicals devoted to the civil arts and sciences: amongst them may be enumerated DALY, *Revue Générale*, 4to., Paris, 1844, v, 339, pl. 19, giving a design with illustrative text by Dupuy, which deserves to be carefully read: and the *BUILDER Journal*, 1858, xvi, 280 (an account of the system of ventilation affording an average supply of 67 ft. per minute in the new buildings erected by Hawkins at Guy's hospital, allowing 1600 to 1700 cubic ft. per patient), 493, 609, and 641, with block plans; 1859, xvii, 402, 417, 435-7, 494. These were followed by the *BUILDING NEWS Journal*, 1861, vii, 939, 959, and 977, giving plans of hospitals at Ashton, Preston, Sheffield, Chatham, Aberdeen, Stoke

Devon, Arbour Hill at Dublin, and 1005 the dimensions and arrangement of the design there given; all which require to be carefully compared with the statements viii, 33 and 104.

The ultimate decision of the military authorities was shewn in the official plans for hospitals issued through the inspector-general of fortifications, and which were reviewed in the *BUILDER Journal*, 1862, xx, 872. This work, 1865, xxiii, 170, gives as the most recent exposition of scientific views the suggestions made by the Société Chirurgicale de Paris, with regard to the reconstruction of the hôtel-Dieu, and of hospitals generally. It demands a minimum of 538 sq. ft. per bed as clear space of site outside the building; a maximum of two stories of ward, and of 200 to 300 beds in each hospital, considering that two small hospitals are preferable to one equal to their united capacity, because the periodical and regular vacancy of wards has been attended with good results. It considers that small wards of fifteen to twenty beds are usually to be preferred (but admits that some classes of patients require a larger space and separate wards), and that the building should not only possess a day ward for convalescents, but another for their meals, so that the day ward may be purified at meal-times. It declares that the wards should be separated by landings and rooms for attendants, and that the officers should have the power of removing all curtains, as the furniture ought not to hinder the free circulation of air. It suggests that the wards should be completely isolated blocks, all having the same aspect, and being exposed without any obstruction to the rays of the sun, to the effects of rain, and to the action of the wind; and that they should be arranged in a single line or in parallel lines at intervals of 260 to 330 ft., in order to obtain an efficient separation and a sufficient current of air. Finally, it declares that no emanation from refuse or effluvium is to be tolerated; and that no abundance of artificial ventilation compensates for an insufficient natural ventilation.

Amongst the most useful books not named in the preceding remarks, may be enumerated: HUNEZOVSKY, *Medicinisch-Chirurgische Beobachtungen*, 8vo., Vienna, 1783, with remarks on the English and French hospitals: TENON, *Mémoires sur les hôpitaux*, 4to., Paris, 1788 (giving a history of designs from the time of Desgodetz, plans of the buildings in Paris, and his idea for one at La Roquette): WATSON, *Thermal Ventilation and other Sanitary Improvements—recently adopted at the New York Hospital*, 8vo., New York, 1851: PARLIAMENTARY PAPERS, viz. *Report on the State of the Hospitals of the British Army*, 1854-5, xxxiii, 1 and 361; *Report—of the Sanitary Commission despatched to the Seat of War*, 1855-6, 1857, ix, 241; *Returns—respecting Netley Hospital, shewing—correspondence or reports which have led to the amended plan*, 1857, xxxvii, 179, 1857-8, xix, 325, xxxvii, 377; *Report of the Commissioners appointed to inquire into—the organization of Military Hospitals*, etc., 1857-8, xviii, 1, and appendix, xix, 1; *Report to the General Board of Health by the Commissioners appointed to inquire into the Warming and Ventilation of Dwellings*, 1857, xli, 309; *Report—by Dr. Mapleton in June 1856, 1857, xxxvii, 105; Paper—being a Medical and Surgical History of the British Army*, 1857-8, xxviii, in two parts; *General Report of the Commissioners appointed for improving the Sanitary Condition of Barracks and Hospitals*, 1861, xvi, 1: RAWLINSON, *Suggestions relative to Civil and Military Hospitals*, read to the National Association for the Promotion of Social Science, 8vo., London, 1857, p. 497: NIGHTINGALE, *Notes on Hospitals*, being two papers read before that Association, 1858; with *Evidence given to the Royal Commissioners on the State of the Army in 1857* (reviewed in the *BUILDER Journal*, xvi, 417); and appendix, *Sites and Construction of Hospitals*, etc., 8vo., London, 1859 (which, having been rewritten for a third edition 1863, has been regarded as a text-book upon the subject); and *Observations on the—Sanitary State of the Army in India*, 8vo., London, 1862, reprinted from the Report of the Royal Commissioners. To the same author is ascribed *Contri-*

tribution to the *Sanitary History of the British Army*, 8vo., London, 1859. The German hospitals have been to some extent described by THORR, *Darstellung*, Munich, 1847; ESSE, *Die Krankenhäuser*, Berlin, 1857; with *Das neue Krankenhaus*, Berlin, 1861; and OPPERT, *Einrichtung*, Berlin, 1859. The hospital at Rotterdam is described by MARJOLIN, *Notice*, Paris, 1862.

From these and the other titles, the references in the following lists of plans and descriptions will be readily understood.

| Date | Place | Name | Architect | Publisher |
|----------|-----------------------|---------------------------|---------------------------|---|
| 1457 | Milan | ... | A. Filarete | { Durand, pl. 20
Husson, pl. 14
Tenon, pl. 3-5
Dur. pl. 29
Hus. p. 16
Ten. pl. 7, 8
(Howard, pl. 10
Dur. pl. 29
Dur. pl. 20
Hus. pl. 17
Hus. p. 16
Ten. pl. 2
Dur. pl. 20
Hus. p. 5
Hus. p. 471
Hus. p. 375 |
| 1607 | Paris | S. Louis | C. Vellefaux | |
| 1735 | S. Denis | Hôtel-Dieu | ... | |
| 1750-61 | Stonchouse
Pauvres | Royal | Rovehead (?) | |
| 1775 (?) | Langres | ... | ... | |
| 1780 | Rocheport | Maritime | ... | |
| 1789-2 | Paris | Cochin (fauv. S. Jacques) | Viel | |
| 1781 | Paris | Maison Royale de Santé | ... | |
| 1788 | La Roquette | ... | Poyet | |
| 1792-802 | Paris | de la Pitié | Viel | |
| 1794 | Turin | di S. Ludovico di Gonzaga | Talucci | |
| 1824-32 | Brest | de Clermont-Tonnerre | Trotté-Dela-
roche | |
| 1821-9 | Bordeaux | de S. André | J. Barquet | Builder, xiv, 51
Hus. p. 364 |
| 1836-44 | Ravenna | Militaire | ... | Hus. p. 10-11
Hus. pl. 16
{ B. xvii, 417-24
Hus. p. 9 & pl. 2
(Nightingale, pl. 4
Hus. pl. 13
{ Ganz-itung,
1861, pl. 381-2
B. vi, 391
B. vi, 535-46
Hus. pl. 13
{ B. xx, 603, xvi,
201; Building
News, v, 527, 8
{ B. xiv, 457; Hus.
pl. 12; N. pl. 2
Hus. pl. 3
{ Hus. pl. 13
N. pl. 4
B. xviii, 264
N. pl. 6
N. pl. 3
B. xxxv, 20-xxi, 296
B. xx, 656
Hus. pl. 15
B. xxii, 806
B. xxii, 546, 503
and Grünig |
| 1837-44 | Paris | du Roule, now Beaujon | ... | |
| 1840 | Philippeville | Militaire | ... | |
| 1840-51 | Paris | du Nord or Lariboisière | Gauthier | |
| 1844 | Rotterdam | ... | ... | |
| 1848 | London | London Fever | C. Fowler | |
| 1848 | Hof gate | Small-pox & Vaccination | S. W. Daukes | |
| 1850 | Bremen | ... | ... | |
| 1853-7 | Bristol | General | W. B. Gilling | |
| 1856 | Netley | Royal Victoria | Mennie | |
| 1856-8 | Vincennes | Militaire | ... | |
| 1858 | Blackburn | Infirmiry | { Smith and
Turbull | |
| 1860 | Brompton | Cancer | ... | |
| 1861-3 | Woolwich | Herbert General Military | Mennie | |
| 1861-3 | Cheltenham | New Buckingham Infirm. | ... | |
| 1862-4 | Birkenhead | Borough | W. Scott | |
| 1862 | Bond | Chalmers's, for 50 | W. L. Moffatt | |
| 1862 | Malta | for Incurables | T. H. Wyatt | |
| 1864 | Bombay | European General | T. R. Smith | |
| 1864 | Dalston | German | { Donaldson
and Grünig | |

Plans of the establishments named in the above list at Philippeville, Blackburn, and Malta, with that at Sidi-bel-Abbès, and also the plan prescribed for the English regimental hospitals, are given in the *Illustrations*, 1863-4-5.

Besides these, Husson gives plans, p. 13-24, of the Paris hospitals Necker and S. Antoine; of the London hospitals Guy and King's College; of Glasgow royal infirmary, and details of that at Portsmouth; p. 449, the maison de santé of the Jewish community at Berlin; pp. 482-490, illustrations of the structures supposed to have been hospitals at Lubeck, Ourscamp, Angers, Beaune, and Cuës; with several interesting plans, including a design by Poyet, p. 28, and another by Gau, p. 41, of the property belonging to the hôtel-Dieu at Paris; and several undated hospitals, including the hôpitaux (Bilgrain) des Enfants malades, S. Antoine, Salpêtrière, Bicêtre, and a maison municipale de santé at Paris; with other examples at Zurich, Hamburgh, etc.

In conclusion, it may be well to reiterate the opinions expressed in the *Builder Journal*, 1856, xiv, 544; 1858, xvi, 417, 493, 609, 641, 680; and 1861, xix, 490, viz. that the correct plan consists of detached wards separated at least by lawns twice as wide as the height of the buildings, each ward being enclosed by four separate walls, and having windows on two sides that open from the ceiling with double sashes glazed; water closets under a separate roof, and divided from the wards by a corridor; the corridors continuous and close for 7 ft. high but open above with piers or columns; galleries with seats in the gardens; comfort of nurses' rooms; and care as to finish of floors, etc.

The tenor of this article, necessarily treated rather historically.

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cally than dogmatically, would be incomplete without a notice of the proposal made in the *Builder Journal*, 1861, xix, 804, for village hospitals, which may be compared with the remarks of DALY, *Revue Générale*, 4to., Paris, 1858, p. 260, pl. 49-53, on the asile impérial pour les ouvriers convalescents, erected 1855-7 at Vincennes, by Laval: this is sometimes mistaken for the convalescent hospital at Vesinet, which was intended for the same class, but in 1858 was appropriated to females.

HOSPITAL CHAPEL. TURNER and PARKER, *Domestic Architecture*, 8vo., Oxford, 1853, ii, 81, observe that in the ancient hospital at Chichester the chapel consists of a sacrum only; and is separated from the hall, or principal chamber, by an open screen with a curtain.

HOSPITALE, HOSPITALIS, HOSPITALIUM, HOSPITALITAS. These words are said to have been applied to buildings in which pilgrims and poor persons obtained relief daily: but perhaps it would be more correct to say that they were places which an incorporated body kept in order as a shelter or refuge; like Elsing's spital in London, which, being open to indigent persons who begged their daily bread, supplied separate chambers to thirty-two residents, and a ward for sixty-eight casual applicants. Similarly Du BREUL, *Theatre des Antiquitez*, 4to., Paris, 1612, p. 953, describes the hospital of Ste. Opportune, afterwards Ste. Catherine, at Paris, as kept by eleven nuns "not cloistered" of the Augustinian order, who were bound to maintain fifteen "large" beds in their two great halls, "recevoir toutes pauvres femmes et filles par chacune nuit, et les heberger par trois jours consecutifs;—aucune fois les lits sont si plains, que aucunes desdites femmes et filles sont contraintes coucher entre les deux portes de la maison, où on les enferme de peur qu'elles ne fassent mal, ou qu'il ne leur advienne inconvenient de nuit."—the same ladies were compelled to collect and bury the bodies of all persons dying in prison, or drowned, or killed in the streets. The hôpital de S. Anastase, called de S. Gervais, at Paris, was also a xenodocheion or lodging, as described by Du BREUL, p. 950; and of this character also was the great building at Lubeck, of which a plan is given in Husson, *Études*, 4to., Paris, 1862, p. 482.

Not only was the word *hospitale* applied to houses of charity for sick paupers, but the houses of refuge became so appropriated: thus the Hôtel Dieu at Paris appears to have been originally a resting place for travellers: Du BREUL also explains the growth of such hospitals by saying that compassionate individuals appropriated their houses to sick paupers passing through the town (a class which in 1795 was excluded from the Parisian hospitals) and endowed the properties; these foundations were subsequently so enriched by gifts and privileges as to become large establishments, which have subsisted almost unscathed to the present time. The localities for such establishments were solitary places, where the building offered a resting place in which travellers, especially pilgrims, found a refuge from weather, wild beasts, and thieves; outside the walls of towns whose gates were closed at fixed hours; inside the towns; and at the entrance to monastic establishments. The *hospitale*, now called *colles* house, at Beck, in the parish of Billingford in Norfolk, was to receive thirteen travellers every night; the *hospitale* of S. Mary at Ripon was to furnish food and lodging for one night to pilgrims, mendicant priests, or other needy persons: i.e. these would be properly called *hospices* or *hostels* rather than *hospitals*. The reception room and infirmary for travellers, provided in the monasteries, will be noticed s.v. HOSPITIUM.

The proper name of the buildings belonging to the "hospitallers" or knights of the order of S. JOHN AT JERUSALEM was in Latin *hospitale* (It. *albergo*, Fr. *auberge*): these are said to be derived from the Celtic words *al berg* "the house", and are evidently related to the English term "harbour"; indeed DUFRESNE, s.v. *Hospes*, gives herbergium as equivalent to domicilium; and s.v. *Hospitale*, proves that word to have had about 1250 the meaning of *hôtel* or mansion.

A complete illustration of a supposed way-side refuge or resting place near Fismes, between Reims and Soissons, is given by VIOLETTÉ LE DUC, *s. v.* Reposeir, who observes that structures for such a purpose are still to be seen in Italy, but have become rare in France, although some which have been converted into chapels may be found in the central districts of the latter country. It is possible that there may have been an error in supposing that the example in question was intended as a refuge; it seems too small to be other than an oratory.

HOSPITIUM. Although the explanations given *s. v.* Hospice, Hospital, Hostel, and Hotel, develop part of the meanings which this word possessed, it may be useful to indicate that although, like the Late Latin terms *hospitale*, *hospitalaria*, *hostellaria*, and *hostitium*, it was applied to a house for the reception of strangers "*diversorium*, *zenodocheum*"; yet, like *hospitalitium*, *hospitium*, *hospitalaria*, *hospitalitas*, *hospitia*, *hosticium*, *hostilia*, and *hostisia*, it was used to express the idea of a house "*domus*, *mansio*". The Roman word *hospitium* was a general term for any place which afforded to a stranger a temporary accommodation of lodging, whether it were the house of a friend, a hired apartment, or a public inn; it even seems to have been applied to the seat reserved for him in the theatre; and it denoted the quarter of a soldier when he was billeted upon a private individual.

In early times a traveller was obliged to carry with him introductions, or to trust to the chance of private hospitality, for lodging in the *hospitium* or guest-house; as in some portions of Europe and in great part of South America at present: when commerce begins, the latter resource fails. The first public houses for the reception of strangers appear to have been established in Crete, and they probably resembled the Asiatic *khan*; these were imitated in mediæval times by the *hospitium* of the monasteries and the detached *hospitale*, as well as by the *hostellaria* which was leased by a private person to strangers: this system of letting apartments soon became a business, and before 1375 the houses that were so used were distinguished by their signs. The general opinion, that *hospitium* should be translated by *hostel* and not by *hospital*, seems to obtain in France as much as in England; for VIOLETTÉ LE DUC, *Dict.*, *s. v.* Construction, pp. 223-31, gives illustrations of the reception room and infirmary for travellers, which *s. v.* Hôtel-Dieu, he calls an "*hospice pour les pauvres*" in the abbey of Ste. Marie at Breteuil. The Italian words *ospitale* and *ospizio* likewise show a similar error, as they are both used to express a *zenodocheum* or lodging for strangers; the only difference that is made between them seems to be the reservation of *ospizio* for a lodging given gratuitously by a pious foundation: *ospedale* and *spedale* are chiefly applied to a nosocomium or infirmary, but are sometimes used instead of *ospitale* and *ospizio*: the confusion has become so great that *foresteria* is the name usually given in an Italian monastery to the guest-house, which some judicious French writers call an *hôtellerie*. The Roman *diversorium* appears to have been a small building of a character similar to the *hospitium*; and this word is frequently translated in Italy by *albergo*, which means both an inn and an asylum.

The guest-house or private dwelling for visitors to a large monastery (in the smaller ones the almonry might be sufficient) was usually near the entrance, but not necessarily within the walls, and some monasteries had internal as well as external *hospitia*. The external position was adopted at the monastery of Sta. Agnese fuori le Mura at Rome, and for the maison des dames at the abbey of Jumièges; to this class may be ascribed the large hall outside the abbey at Bon-Port, near the bay of Paimpol. The guest-house of the monastery called the Sta. Laura on Mount Athos is described as a special building composed of chambers entered from a common corridor having at each end a large room for distinguished visitors. The *hospitium* rebuilt 1235 at S. Alban's, formed an enormous range of apartments, with stables for three hundred horses. Three

guest-houses are shewn in the plan of the monastery of S. Gall, published in the *Archæological Journal*, 8vo., London, 1848, v, 107-9.

The rooms over monastic gatehouses were applied to the reception of guests, the *hospitium* or guest chamber being not unfrequently in such a position, and almost always adjoining the chapel so often found near the entrance of religious houses, as at Stoneley abbey and Peterborough, where abbot Benedict built a gatehouse and a *hospitium* close by it. The guest-house was on the west side of the cloister at Fontanelle and at S. Germain des Prés; at Newstead; Beaulieu; Eastby; and in all the Norfolk houses, according to the opinion of HARROD, *Gleanings*, 8vo., Norwich, 1857, pp. 89, 122, 173, 204, 313; on the west of the great court at Durham, Finchale, and Eastby; on the north at Tynemouth and Bridlington; over the great gate at Thornton; south of the cloister at S. Alban's; south-east at S. Mary's, York; east of the chapter-house at Worcester; south of the refectory at Shrewsbury; detached southward in the great or outer close at Furness and Hulne; north-east of the cloister at Tintern; on the north, over cellars at S. Martin's, Dover; and parallel to the refectory at Glastonbury. The *guesten-hall*, which originally also served as a court of law, at Worcester (it was destroyed 1862, *Builder Journal*, xx, 701) was 65 ft. long, 34 ft. wide, and 45 ft. in height to the collar-beam; it is given in the *Architectural Societies' Reports*, 8vo., London, 1854, pp. 145-50, wherein notice is taken that the hall at Malvern had been destroyed a few years previously. Another at Canterbury is said to have been 150 ft. long and 40 ft. wide.

HOSTEL, HOSTELRY, and HOSTRY. These mediæval words, now supplanted by *hotel*, appear like it to represent *hostilia*, *It. osteria*, *Fr. hôtellerie*. The connection of the Late Latin words *hostalaria*, *hostelarium*, *hostellaria*, *hosticum*, and *hostilia*, with *hospitium* and *hospitaletum* (all meaning an inn), will not surprise those who remember the significations of the Latin *hospes* and *hostis*. "*Herberwed hym an an hostrie, and to the hostiler called*", says LONGLANDE, *Piers Ploughman's Vision*, 1514: and the inns of court are called "*hospitia*" by FORTESCUE, *Laud. Leg. Angliæ*, 49: TURNER and PARKER, *Some Account*, 8vo., London, 1853, iii, 46. The *Builder Journal*, 1840, iv, 373, gives an account of the New Inn built 1450-7 at Gloucester; and 1861, xix, 92, a view of the White Horse Inn at Edinburgh. The old hostleries or inns of Southwark are described by G. R. CORNER in the *Builder Journal*, 1858, xvi, 325; also xv, 368; xviii, 201.

HOT AIR. This subject has been treated in the *Detached Essays*, HEAT; and DRYING CLOSET; and *s. v.* HEAT; and HOT BLAST; but the following additional information may be introduced.

ALDERSON, *Selection from Charges*, etc., 8vo., London, 1858, relating the effect of a vapour bath of 140 degrees, while a hot bath is only 98 degrees, says "Yet it was not unpleasant after all; for hot air does not burn like hot water, as it communicates its heat gradually, air being a bad conductor of heat.—People have been known to bear 400 degrees of heat without much inconvenience. Sir F. Chantrey told me once he had gone into the oven where he baked his molds, which is heated by a nearly red-hot plate at the bottom. He wore thick wooden shoes to protect his feet, and a flannel dress, and was able to bear it very well. That was a heat that would have baked a pie, and yet a man alive would not be heated much above blood heat, or about 100 degrees. Life is able to bear heat which would roast a dead body". Many years since, a man in London tested his power to resist the action of fire and heat, by remaining in an oven for a considerable time while a batch of bread was actually baking; with many other similar demonstrations.

LEWIS, *Fireproof Materials*, etc., given in the *Transactions* of the Royal Institute of British Architects, 1864-5, p. 112, stated the effects of air forced by a fan through a coil of pipes which were heated in a furnace, the air in the coil being con-

veyed by iron pipes underground to brass nozzles fixed in the open air; the air in the pipes was about 650°; it evidently decreased to a great extent at a short distance from the nozzles. The experiments were tried ten feet from the furnace at one of the brass nozzles; brown paper placed in the nozzle burst into flame in one minute; and a strip of ordinary yellow deal also burst into flame in four minutes. There was no appearance of flame or anything to indicate to the eye the presence of heat. On a piece of deal being held half an inch from the nozzle, in ten seconds the wood was slightly clouded, in twenty distinctly scorched; in one minute several portions were made quite black, and in two minutes the area was charred all over. He also explained the cause of a large enclosed roof being on fire from end to end and destroyed as it were in a moment, by strong currents of heated air conveyed into it by shafts from a fire raging in the floor of a lower story; also the danger of heated air being allowed to pass up a hollow iron column, as distinctly recommended by Holme of Liverpool, and by Fairbairn in 1849.

HOT AIR APPARATUS. The name given to any arrangement by which air is heated and then conducted by tubes into a passage, room, etc. It may be introduced for the purpose of warming the air in the room; or for drying, or desiccating it. A hot air apparatus differs from a steam and a hot water apparatus in this respect, that the two latter give out warmth by imparting their heat to the air in the room, etc.; whilst the former gives it directly; or by the communication of heat to air enclosed in pipes. An apparent objection to this mode of heating by air, is the decomposition that takes place in it; but on the other hand, it is very superior to the ordinary methods, when used for the purposes of **DESICCATION**. The degree of temperature to be adopted must depend upon the circumstance of each case. *Detached Essays, DRYING CLOSET; and HEAT.* Many of the modern pedestal stoves may each be called a hot air apparatus on a small scale; some will be noticed *s. v. STOVE.*

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HOT AIR FLUE. A term improperly used for a flue conveying flame and smoke. Thus in hothouses and certain rooms heated by a flue conveying the smoke from a furnace and passing under or along the floor, the flue is a 'smoke flue'; but if a furnace be placed in a chamber into which air is admitted and warmed by the furnace, the flue or channel by which this heated air is carried from the chamber to the room to be warmed, is properly called a 'hot air flue'. Thus the **CALIDUCTS** of the Romans and some modern nations are consequently smoke flues and not air flues. The former are noticed in *Detached Essays, HEAT; and FLUE (EARTHENWARE).*

Danger from the use of hot air flues may be anticipated in some defect arising at the furnace allowing the escape of carbonic gas into the flue or shaft, and thus into the rooms, as occurred at Studeley castle in 1861 (reported in *BUILDER Journal*, xix, 796); and where the flue is formed of wood, as it is very often, the woodwork should not commence for a distance of 5 or 6 ft. from the chamber, in order to guard against flames getting into it through a defect in the furnace.

HOT BLAST. In the old fashioned blast furnaces, air was driven through the fire and the incandescent metal in its natural state, and at the normal temperature of the atmosphere; but about the year 1826 J. B. Neilson of Glasgow invented and took out a patent for applying hot air to the furnaces (*Transactions of the Institution of Civil Engineers*, 4to., London, 1842, i, 81), which method has since been adopted very largely in various factories in England, Wales, Scotland, France, and Germany. The patent expired late in the year 1842. At the present day the air is generally driven into the furnaces at the temperature of 600° (a heat greater than that of molten lead) and even of 800° Fahr., though in the beginning it was rarely above 300°. The process is said to produce an economy of coal equal to about 5 tons in reducing 1 ton of ore, or 5 tons upon a total consumption of 8 tons formerly used; but this ad-

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vantage is considered by some authorities to be compensated for by the decrease that this process has certainly produced in the powers of resistance of the metal. Hot blast iron is, in fact, a very large, loosely crystallised, and very fluid, iron; it makes very fine castings, but it is deficient in tenacity, and requires great care in its application to the purposes of machinery, and for girder castings, by employing it as second runnings from the cupola, and mixing third class pig iron with the first. It is not ascertained to what causes the deterioration in the quality of the iron is owing, whether to the greater facility of reducing cinder iron, to the impurity of the ores, or to the use of raw coal; but the fact of the inequality in the properties of the metal produced seems to show that the causes that affect it in the melting are not thoroughly understood. At any rate, at the present day, hot blast iron should be excluded from all such works as girder bridges, cannon, machinery castings, etc., and from the preparation of bar iron where great strength in the metal is required, together with homogeneous properties. Bessemer's process may have some influence upon the application of the hot blast, but this can only be in cases where steel is employed. Some very interesting remarks upon this process are included in *FAIRBAIRN, Iron, its properties and processes of manufacture*, 8vo., London, 1861, the substance of which may be considered to be, that "iron when it is smelted by the hot blast process is increased in its specific gravity, and it contains a greater proportion of iron, and a smaller proportion of carbon, silicon, and aluminum, than when smelted with the cold blast" (p. 221); and in a previous page the author had quoted the opinion of Hodgkinson, that "the introduction of the heated blast in the manufacture of cast iron had injured the softer irons, but had mollified and improved those that were of a harder nature".

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"The application of cold or hot blast iron and their respective good effects are extremely different, and are found to vary materially; in many instances the iron for foundry purposes is improved by hot blast, while in other cases it could not be applied without producing an injurious effect. The hot blast, by itself, does not, it appears, have an effect upon the quality of the iron; but it is greatly influenced by the quality of the ore, the fuel, and fluxes used in the manufacture, the best fuel of course being that which contains most pure carbon. Generally, cold blast is considered to be superior to hot blast, but this is chiefly owing to the fact that the application of hot blast enables the ironmaster to use inferior produce of a mine, when it would not be possible to make iron out of the same quality of ore with the cold blast. As this may have been repeatedly done in many instances, the quality of hot blast being inferior, it is probable that from this cause arises the prejudice which many engineers have against hot blast, and which is carried to such an extent by some that they will not use it. A mixture of four parts of cold and one of hot blast is thought favourably of by some. It appears, however, that there are no means of detecting hot or cold blasts in pigs or castings. Much depends also upon the care of the furnace man in melting the metal, and upon the state of fusion during the pouring into the molds. Whenever great strength is required, air furnaces instead of cupolas should be used, and where it is not connected with too great an expense, loam instead of green sand should be used for molding"; *HUMBER, Practical Treatise on Cast and Wrought Iron Bridges and Girders*, fol., London, 1857, p. 3. *DUPRÉNOY, Use of Hot Air in the Iron Works of England and Scotland; Translated from a Report made to the Director General of Mines in France in 1834*, 8vo., Lond., 1836.

HOTEL or HOSTEL (It. *albergo, fondaco*; Sp. *fonda*; Fr. *hôtel*; Ger. *gasthof*; Oriental *fundack*). The modern name for a place affording rest and refreshment to travellers, given of late years in Great Britain and America more especially, to very large buildings affording accommodation to them, but not necessarily to horses, as was the case with the older term 'inn'. As such a building may be considered an extensive family resi-

dence, it is needless to describe the requirements of such a place, further than to state that they must be on a scale of sufficient magnitude to furnish to all the inhabitants the comfort and conveniences demanded. The *BUILDER Journal*, 1863, xxi, 92, states that "for the last twenty years the Astor house of New York, costing 360,000 dollars, has been the hotel, when size alone was taken into account. The S. Charles of New Orleans; the Virginia, and the Planters, of S. Louis; and the Burnet of Cincinnati, containing 260 rooms and being in some respects the queen of hotels—have for fifteen years or more been among the larger hotels of the Union. For the last ten years these have been excelled in the north-west by the Tremont of Chicago, which is being eclipsed by the Sherman of the same city, its cost being over 400,000 dollars. There have been many excellent houses of larger capacity and fine specimens of architectural taste, but of less pretensions, as the Newhall at Milwaukee, the Gayosa at Memphis, the Richmond at Chicago, Barnum's at Baltimore, and in S. Louis, etc. The large Metropolitan of New York overtopped the Astor; and the S. Nicholas and Fifth Avenue, of later date, surpassed this in dimensions and modern improvements. These again were all cast in the shade by the magnificent Continental of Philadelphia, which until the Lindel of S. Louis was erected, was certainly not excelled in America." A description of the Lindel hotel, by its architect, Thomas Walsh, is appended.

| Date | Place. | Name. | Rooms. | Description. |
|-----------|---------------------|--------------------------------------|------------------------|--|
| bef. 1851 | New Orleans | S. Charles | 1000-1100 | Builder, 1851, ix, 602; xvi, 413. |
| 1844 | New York | S. Nicholas (Broadway) | 900-1000 | Ditto, 1856, xiv, 520. |
| | Milwaukee | New Hall House | ... | Ditto, 1857, xv, 555. |
| | Wisconsin | Ditto | ... | Ditto, 1858, xvi, 608. |
| | New York | (Madison-square) | ... | Ditto, 1859, xvii, 607. |
| 1858-61 | London | Westminster Palace (Victoria-street) | ... | Trans. R. Inst. Bnt. Arch. 1861-2; B. 1862, xx, 165. |
| 1860-2 | Ditto | London bridge Railway | ... | Ditto; and B. xx, 163. |
| 1862 | Liverpool | Post Office (Canine-place) | ... | Builder, xx, 648. |
| 1860 | New York | (Broadway & Fifth Avenue-street) | 420 bed-rooms | Ditto, xxi, 92. |
| 1860 | Philadelphia | Continental | 800 to 900 guests | Ditto, xxi, 92. |
| 1861 | London | Agricultural, and Farmers' Club | ... | Ditto, xxi, 829. |
| | Saratoga | United States | ... | ... |
| 1862 | S. Louis | London | 550-600 | Ditto, xxi, 92. |
| 1860-1 | London | Grosvenor | 1200 guests | Ditto, xviii, 500; xix, 475. |
| 1861 | Ditto | Charing Cross | ... | Ditto, xxii, 876, 930. |
| 1860-2 | Ditto | Gt. Western Railway | ... | Civil Engineer, xiv, 355. |
| 1863 | Cape May, N. Jersey | Mount Vernon | 42 rooms | ... |
| abt. 1856 | New Jersey | Coast of New Jersey | 2100 beds, 2 | Building News, ii, 663. |
| | Weybridge, Surrey | Oatlands Park | ... | Ditto, iv, 380. |
| 1863-5 | Dover | Clarence | 160 rooms | Illustr. Lond. News, xxiii, 216, 328; B. xxi, 863. |
| 1864-5 | Paris | Hôtel du Louvre | 630 rooms & app. floor | Trans. R. I. B. A., 1864-5. |
| 1864-5 | Ditto | Palais de l'Industrie | 122 rooms | Ditto |
| 1862-4 | Brighton | Grand | 170 bed-rooms | Builder, xx, 914. |
| 1863-5 | London | Langham | 700 rooms | Ditto, xxi, 531; xxiii, 433. |

HOTEL DE VILLE, see TOWN HALL.

HOTHOUSE. The generic name given to any means of keeping plants warm; thus a mere frame and a glass case, as well as an orangery, a conservatory, a greenhouse, a dry stove with or without stages, a bark or moist stove, a pit, a hotbed, a vinery, a peach house, a cherry house, a fig house, or a mushroom house, enter into the list of hothouses; according to LONDON, *Encycl. of Gardening*, 8vo., London, 1850, who gives illustrations of various houses, hotbeds, and pits. He remarks that in the construction of all of these the great object is, or ought to be, the admission of light and the power of applying artificial heat with the least labour and expense. In culinary forcing-houses it is requisite to attend to the angle of the glass roof, so as to obtain most of the sun's influence at the time the fruit within is to be ripened; but in the hothouses of the flower-garden or pleasure-ground the construction ought to be such as to admit as much light as possible in winter; for then in the stoves a heat is kept up by art, which is not to be found

in any natural climate connected with so little light as is then afforded in our latitude. Hence, as a general principle, it may be stated that the roofs of all plant or botanic hothouses should be steep rather than flat; and perhaps the angle of 45° may be fixed on as the fittest average; which was adopted by MILLER, both in culinary and ornamental hothouses, and is fitter for general purposes than any other, according to LONDON, § 5115, although he had previously acknowledged, § 2048 the "fortunate discovery of the late Sir G. Mackenzie in 1815" that the form of glass roofs best calculated for the admission of the sun's rays is a hemispherical figure; and although his illustrations are earlier in date than the introduction of ridge and furrow roofing, they shew an almost upright front to a very narrow house as the best form for houses in which vines, peaches, cherries, or figs are grown. A pit is distinguished from a frame or a glass-case by its having walls, and perhaps a flue. A hotbed or forcing frame may have no constructed bottom, or a moveable one, or a fixed bottom. The pine pit is often of two classes, the succession house and the fruiting house; but sometimes a third is added for the earlier stage of nursing the plants which would otherwise have been reared in the succession house. A pit with a passage in it is generally employed for forcing fruit trees in pots, but herbaceous vegetables are generally forced in a sunk pit. The warmth is obtained in some cases by mere exclusion of the external air; in others by bottom heat from bark or manure; and in others by artificial means: open fires, furnaces or ovens, smoke flues, hot air, and steam, have successively been adopted, but have yielded in efficacy to hot water in large pipes (say 3½ to 4½ ins. diameter in general) for assuring the requisite degrees of warmth to each class of house, which may be taken at 35° to 45° for the greenhouse, 45° to 55° for the dry stove, and 55° to 75° or 80° for the moist stove. The necessity for admitting warm fresh air has been fully recognised; but as it involves care and expense, the aeration of plants in hothouses is almost always entrusted to the gardener's appreciation of the means of ventilation that may be provided: this ventilation is doubtless less effectually provided by the usual shuttered louver-board than by the raking sashes, which may be made by simple mechanism to open to any reasonable extent and to close simultaneously, or even to work in concert with the upright lights.

Much that has been described *s. v.* CONSERVATORY applies to the hothouse. It will be well to notice that the new houses at Chatsworth are made with fixed sashes at the top, so as not to interfere with the growth of creepers under the roof; and that ventilation is obtained by openings in the back wall near the glass, closed by shutters.

T. H. L.

For heating a greenhouse, a stove, or a conservatory, GLENNY decides that the hot water system is the most effective for all ordinary purposes; and all the pipes should be applied to the lowest part of a house; with a common lean-to, the proper place is in front; with a ridge, it should go all round, under the lowest part of the roof. A conical boiler is the best adapted for the purpose, as being the most economical. A range of houses equal to twelve hundred feet; another equal to thirteen hundred feet, can be properly heated by one boiler. 'Cranston's patent buildings for horticulture' are commended by the Royal Horticultural Society of London; they are shaped like a pointed arch, or half the arch if against the wall, and have five lights down each side, the ends of which are raised about six inches above the frame of the light under it, and each opening can, by a simple apparatus, be at once shut up the entire length of the building. They are made at Birmingham. GLENNY has constantly urged that a greenhouse can be built for one shilling per foot superficial, measuring from the bottom of the foundations up the lights, along the rafters to the ridge and down the other side, and including the superficial quantity of the ends. For a lean-to building only the measure to the wall is taken, that being supposed to be already built. Two six feet lights will give depth enough for a small concern: the front wall

should be 2 ft. 6 ins. high, the glass upright 18 ins., and the top of the lights 9 to 10 ft.; the top six feet light must slide down over the other: the stage at the window 2 ft., a path 2 ft., and the back stage to stop with the roof. He also says that "the best and most simple system of ventilation for greenhouses is that of Messenger's at Loughborough; the ventilation, much or little, is complete." Hothouses, on the principle invented and patented by Sir J. Paxton, combining simplicity, cheapness, excellence and durability, were extensively advertised in 1860, as given with wood-cut and prices in the *BUILDER Journal*, Advs., October 6.

HOT SHORT IRON, see CINDER IRON.

HOUSE (Gr. *oikos*, *oikia*, *oîkos*; Lat. *domus*, *ædes*, *domicilium*, *villa*, *aula*, *sedes*; It. *casa*, *casino*, *villa*, *vigna*, *villetta*; Fr. *cassine* (Provence), *closerie* (1734), *maison*, *maison de ville*, *maison de campagne*; Sp. *casa*, *quinta*; Ger. *haus*, *wohnhauus*, *wohnung*). The term for a private dwelling, in contradistinction to those intended for rulers, ecclesiastical bodies, or official persons. The various parts of a house are so fully detailed under their different heads in this work, that to treat of them here would be useless repetition.

For a classic house, the articles ANDRON and GYNÆCONITIS will express the chief differences between those of the Greeks and of the Romans: while *DOMUS* and *INSULA*, give the differences between detached houses and those in blocks. The chief apartments and adjuncts to classic houses will be found under the following heads—*ALA*, *AMBULACRUM*, *AMBULATIO*, *AMPHITHALAMUS*, *ANABATHRA*, *ANDRON* or *ANDRONITIS*, *ANTITHALAMUS*, *APODYTERUM*, *APOTHECA*, *ATRIUM*, *AULA*, *AVIARIUM*, *BALNEUM* (see also *Detached Essay*, *BATHS*, ANCIENT), *BASILICA*, *BIBLIOTHECA*, *BICLINIUM*, *CAVEDIUM*, *CORYCEUM*, *CRYPTO-PORITICUS*, *CURRICULUM*, *DIETA*, *DIETULA*, *DIAULON*, *DISPLUVIATUM*, *EXHEDRA*, *FAUCES*, *FUNARIUM*, *GRANARIUM*, *GYMNASIUM*, *GYNÆCEUM*, *HORREUM*, *HORTUS*, *HYPÆTHRUM*, *HYPOCAUSTUM*, *IMPLUVIUM*, *LAQUEAR*, *LARARIUM*, *LATRINA*, *LITHOSTROTON*, *MENIANUM*, *MUSIVUM OPUS*, *NYMPHÆCUM*, *ŒCUS*, *OSTIUM*, *PALESTRA*, *PENETRALE*, *PERGULA*, *PERIBOLUS*, *PERIDROMUS*, *PERISTYLIUM*, *PISCINA*, *PINACOTHECA*, *PORITICUS*, *PRÆCINCTIO*, *PRÆFORNIUM*, *PROTHYRUM*, *PUTEUS*, *QUADRIFORES*, *SCALA*, *SECRETARIUM*, *SEPTA*, *SOLARIUM*, *SPECUS*, *STABULUM*, *TABLINUM*, *TABULATUM*, *TEPIDARIUM*, *THALAMUS*, *THERMÆ*, *TRICLINIUM*, *TUSCANICUM*, *VILLA*, *VIVARIUM*, *XENODOCHIUM*, and *XYSTUS*.

For a mediæval house and its adjuncts, see the articles *AMBULATORY*, *BAILEY*, *BARBACAN*, *BASE-COURT*, *BUTTERY*, *CELLAR*, *CHAMBER*, *COURT*, *DOMESTIC CHAPEL*, *DONJON*, *DORMITORY*, *DOVECOT*, *GALLERY*, *GARDE-ROBE*, *GATE HOUSE*, *GRANGE*, *HALL*, *HOUSE*, *KEEP*, *KITCHEN*, *LARDARIUM*, *LAVATORIUM*, *LOFT*, *MANOIR*, *MOATED HOUSE*, *ORATORY*, *PARLOIR*, *PIGEON HOUSE*, *PLEASANCE*, *PORCH*, *PORTER'S LODGE*, *PRESENCE CHAMBER*, *PRIVY CHAMBER*, *REFECTORY*, *SEWERY*, *SLYPE*, *SOLAR*, *TIMBER HOUSE*, *TOWER*, *TRANCE*, *VESTIARY*, *VICE OR VYS*, *WARDROBE*, *WITHDRAWING ROOM*.

For a modern house, see the articles *ANTE-CABINET*, *ANTE-CHAMBER*, *ANTE-ROOM*, *ARCADE*, *BALL ROOM*, *BANQUETING ROOM*, *BASEMENT*, *BATH ROOM*, *BEDROOM*, *BEER CELLAR*, *BILLIARD ROOM*, *BOUDOIR*, *BREAD ROOM*, *BREAKFAST ROOM*, *BUTLER'S PANTRY*, *CABINET*, *CARD ROOM*, *CASINO*, *CHAMBER*, *CHINA CLOSET*, *CLOAK ROOM*, *CORRIDOR*, *COURT*, *CUPBOARD*, *DINING ROOM*, *DRAWING ROOM*, *DRESSING ROOM*, *EATING ROOM*, *ENTRESOL*, *GALLERY*, *GARRET*, *GENTLEMAN'S ROOM*, *GUN ROOM*, *HALL*, *HOUSEKEEPER'S ROOM*, *KITCHEN*, *LARDER*, *LAVATORY*, *LIBRARY*, *LINEN ROOM*, *LOBBY*, *LUMBER ROOM*, *MANSION*, *MUSIC ROOM*, *MEZZANINE*, *MORNING ROOM*, *NURSERY*, *OFFICE*, *PANTRY*, *PARLOUR*, *PASSAGE*, *PLATE ROOM*, *PORCH*, *PORTICO*, *RECEPTION ROOM*, *SALOON*, *SCHOOL ROOM*, *SCULLERY*, *SERVANTS' HALL*, *SHOP*, *SMOKING ROOM*, *STAIRCASE*, *STEWARD'S ROOM*, *STILL ROOM*, *STORE ROOM*, *STRONG ROOM*, *STUDY*, *VESTIBULE*, *VILLA*, *WARDROBE*, *WAREHOUSE*, *WASHHOUSE*, *WASHING PLACE*, *WATERCLOSET*, *WINE CELLAR*, and *WORK ROOM*.

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For the outbuildings and other adjuncts of a modern house, see *APIARY*, *APPLE ROOM*, *ARBOUR*, *BAKEHOUSE*, *BARN*, *BREW-HOUSE*, *CART SHED*, *CATTLE SHED*, *CHEESE ROOM*, *CONSERVATORY*, *COAL HOUSE*, *COACH HOUSE*, *COW HOUSE*, *DAIRY*, *DOG KENNEL*, *DRYING ROOM*, *FARM BUILDINGS*, *FOWL HOUSE*, *FRUIT ROOM*, *GRANARY*, *GREENHOUSE*, *HARNESS ROOM*, *HAY LODGE*, *HOG STYE*, *HOMESTEAD*, *HOTHOUSE*, *ICE HOUSE*, *LAUNDRY*, *LODGE*, *LOFT*, *LOOSE BOX*, *OAST HOUSE*, *OUTHOUSE*, *OVEN*, *PIGEON HOUSE*, *PRESS ROOM*, *RACKET COURT*, *SADDLE ROOM*, *SCULLERY*, *STABLE*, *SUMMER HOUSE*, *SWIMMING BATH*, *TERRACE*, *TOOL HOUSE*, and *WOOD HOUSE*.

A. A.

HOUSEKEEPER'S ROOM. The sitting room of the housekeeper in large houses, in which also the upper servants sometimes take their meals. Where there are no separate china, linen or store rooms, it is usual to fit up this room with closets for china and glass, fruit, biscuits, tea, coffee, sugar, spice, etc., etc., and sometimes with presses and drawers for linen, towels, cloths, etc., etc. It should be near the kitchen for the facility of serving out stores, and for inspection. A. A.

HOUSEMAID'S CLOSET (Fr. *décharge*). A place provided in large houses to keep brooms, brushes, pails, etc., and where hot and cold water can be obtained; a sink is sometimes provided for washing small utensils. In houses of lesser rank a closet on the upper landing of a staircase or in a passage is used for this purpose.

HOUSE MOVING. Although the common operation of moving houses in North America has excited much surprise as a novelty, it would appear not to have been unknown even in the fifteenth century in England, as HORMANUS, *Vulgaria*, 4to., London, 1519, fol. 244, notices that "Hoc ædificium trãfferri potest: subiectis trocis et lapsibus; This house may be removed with trocles; and slyddis": and "It shalbe done with myght of men and oxen". Stow, *Survey*, edit. by STRYPE, fol. Lond., 1720, p. ii, notices that "a garden house, close by his south pale or wall, stood somewhat in (Sir T.) Cromwell's way, and obstructed his convenience: Therefore without any more ado, or having the leave of the proprietor, his workmen loosed it from the foundation, and bare it upon rollers, and ran it two and twenty foot into Mr. Stow's garden, before he heard anything of it:—half of his garden being thus taken away".

The operation of moving houses is often practised in New York. Most of the old streets being narrow and tortuous, in the course of improving them, many of the old houses are moved *en masse* to a new site. This was at first only attempted with houses formed of wooden framework, but those of brick are also now moved. One, of four stories, 50 ft. deep by 25 ft. breadth, was moved back 14 ft. 6 ins. by the following operations. The first step is to prepare a foundation for the walls on the new site which the house is intended to occupy. A trench is next cut round the outside of the house, the lower floor removed, and the earth excavated from the interior so as to expose all the foundations. Beams of timber, A,



fig. 1, about 12 ins. square, are then arranged at distances of 3 ft. from centre to centre, at right angles to the direction in which the house is to be moved, their ends being allowed to project about 3 ft. each beyond the building. A series of screwjacks, about fifty in number, are then placed under the ends, each resting on a beam or on stone, and carefully fixed to prevent them from canting or twisting on application of pressure. The beams, A, are then screwed up into close contact with the walls, and the intermediate points of support being carefully removed, the whole weight is brought to bear on the beams. Two strong beams, B and C, are then placed

A A

under the first beams so as to carry them, the lower beam, c, forming the roadway on which the upper one slides when the house is moved, and this must be fixed firmly to the beams, A,



by cleats and spikes. A series of holes are then made in the other two walls over the beams, A, through which other beams, D, fig. 2, are placed, their ends being supported on a beam placed on B; the intermediate points of support are then cut away as before, and the whole weight of the house then rests upon the lower beams, B and C. A powerful screwjack is fixed to each of the road beams, C, and abut against the one over it, B, both beams being well greased; a groove in the upper and a corresponding feather on the surface of the lower one, insure a motion in the direction of their length. As soon as the screwjacks have worked their length, they must be unfastened and again refixed, and the beam road lengthened. When the house has been brought directly over the foundation prepared for it, the spaces between the beams must be filled up; screwjacks again put up and the weight allowed to bear on the new supports, and so on. The operation is attended with very great risk, and much caution is necessary to prevent accidents. Its success depends chiefly upon getting a solid and unyielding base for supporting the screwjacks, and for the prolongation of the road beam; and the screwjacks must be worked simultaneously. Sometimes the tenants do not remove their furniture or goods. The time occupied in actually moving the house was seven hours, though the whole operation took about five weeks; and was contracted for at about £200. Mr. Brown and his father were the first persons who attempted the operation of moving houses, which they had followed for fourteen years, and had removed upwards of a hundred houses without any accident, many being of brick. A church, holding about 600 to 1,000 persons, with galleries and a spire, was moved 1,100 ft., but being built entirely of wood, the operation was much less hazardous; STEVENSON, *Civil Engineering in North America*, 8vo., London, 1838, p. 309-16; reprinted in WEALE, *Rudimentary Series*.

A communication from F. Catherwood was read 6 Dec. 1836 at the Royal Institute of British Architects, detailing the moving back for 21 ft. of a brick built leather warehouse, No. 144 Fulton-street, New York, four stories and 45 to 65 ft. in height, 31 ft. wide, and 72 ft. deep. The operation took twelve hours, and was performed without a crack occurring, the business being carried on during the time. The persons who performed the feat were common workmen guided alone by experience. The cost was between one quarter and one-fifth of the expense of rebuilding the house. The *BUILDER Journal*, 1843, i, 556, gives a short extract from a work by Mrs. Trollope of such undertakings at Cincinnati with timber houses. The same *Journal*, 1854, xii, p. 284, notices that "the State house of South Carolina, in Columbia, has been removed from the position which it has long occupied, to make room for a new and more imposing capitol on its site—without any plastering being disturbed; it was done by a Yankee from Massachusetts." About 1858, the newspapers stated that the whole town of Chicago, Illinois, in the United States, was raised in order to secure better drainage, the houses being situate on a level with the river and the lake Michigan, on the margin of which it extends for about a mile. One house is stated to have required 1500 screwjacks, each worked by two men.

As a kindred subject, should be mentioned the moving of Sunderland lighthouse a distance of between 400 and 500 ft.; it is of stone, 15 ft. in diameter and 62 ft. high; an account is given in the *CIVIL ENGINEER*, etc., *Journal*, 1841, iv, 243, 378.

HOUSE OF CORRECTION, see PRISON.

HOUSE PAINTING, see PAINTING.

HOUSING (Fr. *enclaver*). The term given in joiner's work to a method of joining pieces of wood at an angle without mitering; it is chiefly used for skirtings, dadoes, etc. The moldings are cut so as to interpenetrate one another, as is shewn in the hatched portion at A. The object is to prevent the winding of the stuff at the angles. The strings of stairs are housed by a shallow excavation the full thickness of the tread, riser and nosing, exactly fitting the outer profile or section line thereof, and then wedged up and glued; but skirtings are generally housed only to a portion of the thickness, as being so near the wall there would not be held enough. The term is also used in masonry. A. A.



In partitions formed of studding (Fr. *sablière*), the housing (Fr. *chambree*) is the insertion of the solid steps on the sloping head of the partition.

Housing, is also used by bricklayers for a tile or brick warped or cast crooked or hollow in burning; tiles are apt to be housing or hollow on the struck (or upper) side; and bricks on the contrary side; *Builder's Dictionary*, 8vo., Lond., 1734.

HOUSING. This term is also used for a niche, in the contract with the "marbler" for the tomb at Warwick, "in and about the same tombe to make xiv principall housings, and under every principal housing a goodly quarter for a scutcheon of copper and gilt to be set in"; and in that with the "founder", who was to make "of the finest latten, to be gilded, that may be found, xiv images embossed of lords and ladyes in divers vestures, called weepers, to stand in housings made about the tombe". BRITTON, *Arch. Antiq.*, 4to., London, 1814, iv, pp. 12-3. "Tabernacles appeles hovels ove (avec) gabletz de dit metall endorrez", occurs in the contract for the tomb of Richard II in Westminster abbey. 17.

HOVEL. A portion of a farm building; it has a roof, but the sides are generally open. The term is sometimes used for an unenclosed shed having a lean-to or penthouse roof; and it is very often applied to a mean habitation, such as a cabin or bothie.

HOVELLING. A mode of preventing chimneys smoking by carrying up two sides of it higher than those receiving the strong currents of air. Apertures are sometimes left on all the four sides, so that when the wind blows over the top the smoke may escape on any side below. 1. 2.

The sides when carried up are often covered with tiles or bricks in a pyramidal form, or other material, as a half circle or rounded tile, in order to get rid of the eddies caused by adjoining buildings or lofty trees higher than the chimney, in which cases the covered side must be towards the object producing the inconvenience. *Illustrations*, s. v.

HOWARD (HENRY), earl of Surrey, born 1517, died 1547, "designed and built Mount Surrey on S. Lennard's hill, near Norwich, a residence of more elegance and taste than any of those erected in the reigns of Henry VII and VIII, after his return from the court of the Medici at Florence; it is therefore probable that it exhibited some imitations of the Italian style"; DALLAWAY, *Anecdotes*, etc., 8vo., London, 1800, p. 61.

HOWARD (HENRY), born about 1539, created earl of Northampton 1604, died 1614. He was the second son of II. Howard, earl of Surrey; and "planned" his own residence, Northampton house, afterwards called Suffolk house, now Northumberland house, Strand; and is said to have designed Audley End or Inn for his nephew Thomas Howard, earl of

Suffolk, to whom he left by will his own house. LLOYD, *State Worthies*, 12mo., London, 1670, p. 781, says "His designing of Audley End and building of Suffolk house (shewed him) an architect". M. Glover, B. Jansen, and perhaps G. Christmas, are said to have built 1605, or completed, Northampton house.

HOWARD (THOMAS), born 1580, created first earl of Suffolk 1603, died 28 May 1626. He built 1603-16 Audley End, Essex, and probably superintended its erection with the assistance of his uncle Henry HOWARD, earl of Northampton, at an expense of £190,000. The model in wood, part of which still remains, is said to have been procured from Italy; the house consisted of two quadrangular courts; the gallery, 226 ft. long, which formed the east side of the inner court, was pulled down 1750, and previously three sides of the principal court had been destroyed by the advice of Sir J. Vanbrugh. The hall and saloon are still considered fine specimens of the style. J. Thorpe and B. Jansen are both mentioned to have been the architect; NEALE, *Seats*, i, 1818. Thomas Howard added the river façade to Suffolk now Northumberland house, Strand—a view is given in WILKINSON, *London Illustrated*, fol., 1819-25. Charlton, in Wiltshire, said to have been designed by J. Jones, is attributed to Howard after his marriage with the coheirress of Sir H. Knevit of Charlton.

HOWARD (HENRY), earl of Norwich 1672-84, is noticed in a letter dated Oxford, 7 June 1668, from Sir C. Wren to the Royal Society respecting the new college. "When I waited upon his honour, Henry Howard of Norfolk, he took delight to shew me some designs he had thought of himself for your building, and commanded me to trace out to him what I had considered, the same in effect I shewed you in London". ELMES, *Memoirs of Wren*, 4to., London, 1823, p. 237.

HOWDEN'S HOT AIR DISPENSER, "for ventilating large buildings in summer with cool air, and with warm air in winter, by means of an improved fire contrived to feed itself for several hours, requiring but little attendance, and constructed so as to burn its own smoke, by which more warm air is dispensed from a small fire and with less fuel than by any other method known". This invention was in use before 1829, at which period and for some years later it was very extensively used. It was a clumsy contrivance, consisting of an outer lining or casing with a coked and double smoke flue concealed within it; the expense also was very great (one for a moderate sized house cost £85, fixed), and it was soon superseded.

HOWE'S TRUSS. A system introduced in America, about the year 1844 by Howe, an engineer of Springfield, Massachusetts, and which has since been largely employed in England and Ireland, and on the continent, wherever there has been an interest in the adaptation of timber. The system consists of a top and bottom stringer, maintained in their places by a series of cross braces in the shape of a lozenge, sometimes in one, sometimes in several series in the height; these braces meet in a cast iron shoe at top and bottom, and are maintained in their position by bolts passing through the stringers and the shoes. In Russia the laws which regulate the resistance of such beams have been carefully studied, and are recorded in great detail by COLLIGNON, *Théorie élémentaire des Poutres Droites*, 8vo., Paris, 1865, which is the best account of the system yet published.

The strength of the Howe girder depends upon the resistance of the top and bottom stringers to an effort transversal to their longitudinal axis, assisted by the resistance offered by the cross bracing to an effort of deformation. This it is evident cannot take place so long as the cross braces are retained in their position, which is effected by means of the bolts that keep the shoes in their places; but it follows from this that the whole strength of the beams must depend on that of the bolts, and thence the danger of this system of girder. To cause the sudden rupture of such an assemblage it may suffice that the bolt be screwed up tightly, and a sudden cooling of the tem-

perature should cause them to shrink; or that, on the contrary, the unexpected prolongation of the bolts should deprive the cross braces of their points of resistance. For these reasons the Howe girder is seldom used for the permanent roadway of railway bridges; though it is well adapted for scaffolding not exposed to great variations of temperature, and which admit easily of being regulated when once in place. The Russian engineers, who have erected many constructions upon this system, which seemed to be well adapted to the local circumstances of their markets, have adopted the following dimensions in the details of the girders; but it must be observed that wrought iron lattice beams in the erection of bridges of large even they have now abandoned the use of it in favour of span. The warping of the timber must be a great source of danger in the deep beams required for great openings.

Table of Dimensions of Principal Bridges upon the Nicholas Railway.

Three beams—Distance apart of beams, 14 feet, from centre to centre.

| | Dimensions corresponding to Openings. | | | | | | | | | |
|----------------------------------|---------------------------------------|-------------|--------------|--------------|--------------|---------|---------|-------------|-------------|--------|
| | 30 ft. | 27½ ft. | 24½ ft. | 17½ ft. | 17 ft. | 17½ ft. | 14½ ft. | 14 ft. | 10 ft. | 30 ft. |
| Distance between bolts | 9 ft. | 8 ft. 6 in. | 7 ft. 6 in. | 7 ft. | 6 ft. 6 in. | 6 ft. | 6 ft. | 5 ft. 6 in. | 4 ft. 6 in. | 30 ft. |
| Height of girders | 23 ft. | 22 ft. | 21 ft. 6 in. | 17 ft. 6 in. | 16 ft. 6 in. | 14 ft. | 14 ft. | 10 ft. | 6 ft. | 30 ft. |
| Length of bearing | 8 ft. | 8 ft. | 6 ft. | 6 ft. | 5 ft. | 5 ft. | 5 ft. | 5 ft. | 3 ft. | 30 ft. |
| INCHES. | | | | | | | | | | |
| Section of bottom stringer | 11 x 24 | 14 x 31 | 13½ x 30 | 12 x 28 | 12 x 27½ | 12 x 24 | 12 x 18 | 8 x 10 | | |
| supplemental bracer | 11 x 28 | 11 x 28 | 11 x 30 | 10 x 28 | 10 x 27½ | 10 x 24 | 9 x 18½ | 7 x 10 | | |
| Section of upper stringer | 12 x 30 | 11 x 30 | 11 x 30 | 10 x 28 | 10 x 27½ | 10 x 24 | 9 x 18½ | 7 x 10 | | |
| supplemental bracer | 12 x 28 | 11 x 28 | 11 x 28 | 8 x 8 | 7½ x 7 | 7 x 7 | 6 x 6 | 4½ x 4½ | | |
| Section of cross bars of lozenge | 9 x 9 | 9 x 9 | 8 x 8 | 4½ x 7 | 4½ x 6 | 4 x 6 | 3½ x 6 | 3½ x 6 | | |
| Section of cross braces for wind | 4½ x 7 | 4½ x 7 | 4½ x 7 | 4½ x 7 | 4½ x 6 | 4 x 6 | 3½ x 6 | 3½ x 6 | | |
| backing of girders | 12 x 11 | 12 x 11 | 12 x 11 | 12 x 14 | 12 x 12 | 12 x 12 | 12 x 12 | 12 x 12 | | |
| Height and base of shoes | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | |
| Diameter of bolts | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | |

The accompanying woodcuts represent a portion of one of the spans of the temporary bridge over the Dvina at Dunabourg near S. Petersburg. Fig. 1

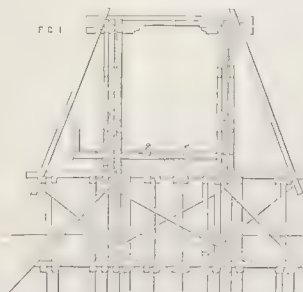
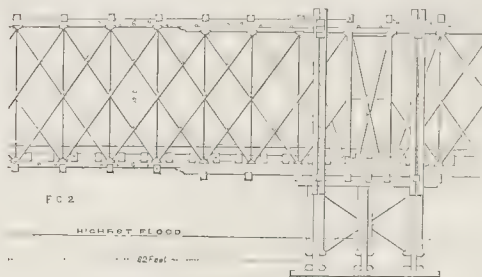


Fig. 1 Section.

bridge at Chambly near Montreal, and a number on the same

Fig. 2, the elevation of the outside of the girder; the staging or piers stand upon timbertressels placed below the line of the river flood. O. R. B. The inventor obtained a patent in the United States, which he disposed of to Boody, Stone, and Co., who erected the

plan, of much greater span, for railways. This timber bridge is 1030 ft. long, having six piers and two abutments, one of the



spans being 77 ft., the other spans ranging from 154 ft. to 160 ft., the trusses being 18 ft. high from the top to the bottom of the chords, and 22 ft. 1 in. wide from outside to outside; a description with details is given in *BUILDER Journal*, 1847, v, 433-5. The system is also shown in the *ALLG. BAUZEITUNG*, 1845, pl. cexliiii; and in the *ANNALES DE LA CONSTRUCTION*, fol., Paris, 1855, i, pl. 5, being the bridge at Wittenberge in Prussia, 176 ft. span. An *Investigation of the Angle Block of Howe's Truss*, is given in the *Transactions of the Franklin Institute*, 8vo., Philadelphia, 1855, p. 306.

HOWK. A term used in the West Riding of Yorkshire for the word 'dig'.

HOZ QUARRY (LA), in the neighbourhood of Cuenca in Spain, furnishes a dark stone employed in the northern cloister, built 1577-83, of the cathedral in that city.

HUAMANGA or **GUAMANGA** (*Guamagna* of MORONT), formerly called San Juan de la Vittoria. The capital, founded 1539, of the department of Ayacucho in Peru. It consists of large squares lined by stone houses in gardens, surrounding a few public buildings: of which the most important are the highly praised cathedral, dedicated to the Blessed Virgin; the episcopal palace, at a little distance from it; five monasteries; two nunneries; and a college. 96.

HUBALD, of Liège, was reconstructing 1033-40 the church and the monastery at Stavelot, when this architect (who was probably a layman) was nearly killed by a fall in the chancel, according to EVERHELMUS, *Vita Popponis*, printed in PERTZ, *Monumenta*, fol., Hanover, 1854, xiii, 306.

HUBERT (. . .) succeeded 1793 to Giraud as architect to the Louvre at Paris, and was himself succeeded 1798 by Raymond: CLARAC, *Musée*, 8vo., Paris, 1841, i, 660.

HUBBUCK'S WHITE, see ZINC WHITE.

HUDDLESTON STONE. A member of the magnesian limestone series met with at the village of the same name, one mile from Sherborne in Yorkshire. It is chiefly composed of carbonate of lime and carbonate of magnesia in nearly equal quantities, and often contains crystals of both; but veins of earthy matter seriously injure the stone, and cause it to decay when they are exposed to the weather. Its colour is whitish cream; the weight of a foot is about 138 lbs.; and the crushing weight about 2,331 lbs. per in. super. The price of labour on this stone, under any circumstances, is the same as that on Portland, though the commissioners state that it is less; the cost of transport will always be against its introduction into the London market. Locally it would be a very valuable material. Report of the Commissioners for selecting Stone, etc., fol., London, 1838. When acted upon by artificial frosts according to Brard's process, this stone lost less than '04 of its weight by disintegration, or one grain in 2,365; whereas some of the other stones lost 1 in 174, and most of the oolitic stones from 1 in 300 to 1 in 400.

The quarries are very well worked; the blocks are well squared, some 11 ft. long; others 6 ft. 6 ins. by 4 ft.; and 6 ft. by 2 ft. 6 ins. There appear to be no regular beds or joints;

the depth worked is considerable, probably about 35 ft.; there is 8 ft. of head; no water in the quarry; nearly all the blocks are free from vents. There are lines varying in colour parallel to the beds. Glass veins are occasionally found. The upper part of the quarry is not quite so uniform in texture as the lower part; it appears extensive enough to supply any reasonable demand; C. H. SMITH, MS., 1837-8, at the Royal Institute of British Architects.

Perhaps the earliest notice of the use of this stone is found at York, where the dean and chapter in 1385 obtained a lease of the quarry for eighty years for the works at the cathedral, but in that building Huddleston stone had been used much earlier, probably being the old materials of the hall at Sherburn, close to that village, and granted to the use of the fabric in 1361. In 1465 the term having expired, the lease was renewed for nineteen years with Sir J. Langton, kat., certain annual payments being made to the owners for the stone required. The roll of 1543-4 is the latest in which this stone occurs, as "pro lx tonn petrarum apud Huddleston quarell, 50s."; *SURREY SOCIETY, Fabric Rolls of York*, 8vo., Durham, 1859, pp. 4, 72, 110. BROWNE, *York Cath.*, 4to., London, 1838-47, p. 248, considers the large tower and the bell tower to have been chiefly erected after 1465 of this material. King Henry VI, cir. 1448, granted a quarry at Huddleston to the provost of his college at Cambridge for the construction of the buildings, and it is generally stated to have been used in the earlier part of the chapel: it was also used at his college at Eton. Stow, *Survey*, edit. 1598, p. 380, describing the chapel of Henry VII at Westminster, commenced 1503, states that "the stone for this worke (as I have beene informed) was brought from Huddlestons quarrie in Yorkshire." It was also used 1619-22 in the banqueting house at Whitehall, apparently in the interior only, as noted by CUNNINGHAM, *Handbook*, 8vo., London, 1850, p. 551; and in 1835-6, by Sir R. Smirke for the new facing, 6 ins. thick, to the interior of Westminster hall, the stone being obtained from a quarry on the estate of R. O. Gascoyne, esq., at Parlington, near Leeds, which appears to have been wrought two centuries earlier, and was brought into fresh notice by the opening made on account of the Leeds and Selby railway; BRAYLEY and BRITTON, *Palace of Westminster*, 8vo., Lond., 1836, p. 441. It was used in the large south window of the same building, where the stone has stood remarkably well; and later, in certain portions of the new church at Doncaster; in the balustrading of the great staircase at the British Museum; and elsewhere. At Leeds (the quarry is about fourteen or fifteen miles distant) it has been largely used, and where, with practical men, it is more highly valued as a building stone than any other sort. The chief objection against its being much used is the difficulty with which it is worked.

HUE. The modification which a primary colour undergoes from the addition of a small quantity of another. Thus the expression *all the hues of blue* designates all the scales of colour, which remain blue but differ from pure blue; each hue comprehending the (tones, *CHÈVREUIL*) tints and shades which constitute a scale more or less allied to the blue scale. This definition also applies to secondary and tertiary colours, which indeed are hues themselves, according to REDGRAVE, *Manual of Colour*, 8vo., London, 1853.

HUEBSCH (HEINRICH), born 9 Feb. 1795 at Weinheim in the Palatinate, matriculated 1813 at Heidelberg, became 1815-7 a pupil of Weinbrenner at Karlsruhe, and studied 1817-20 at Rome. After visiting Athens and Constantinople, he went home 1820 to pass his professional examination, and returned 1822 to Italy. Having published a work, *Über Griechische Architektur*, 4to., Heidelberg, 1822 (enlarged 1824); and with Heger, *Malerische Ansichten von Athen*, Darmstadt, 1823, he became 1824 one of the teachers in the Städelsche-kunst-institut at Frankfurt-am-Main, and 1827 residenz-baumeister and member of the bau-direction at Karlsruhe, declining the position of teacher of architecture at the academy in

Dresden. He published *In welchem Style sollen wir bauen?*, 4to., Karlsruhe, 1828; and was 1829 made baurath; 1830 director of the bausschule and member of the gewerbschul-commission; 1831 baurath, having declined the post of baurath to the duke of Coburg; and 1842 baurath. In consequence of his connection with the schools he was sent 1834 to Munich, 1840 to Paris, 1842 to Dresden and Berlin, 1849 (at which period he became a Roman Catholic) and 1853 to Italy, 1858 to Munich, and 1859 to Italy.

His earliest principal works were 1825-9 a Protestant church at Barmen; 1826-9, with Burnitz, the waisenhaus (orphan asylum) at Frankfurt; 1829-33 the finanz-kanzlei at Karlsruhe; 1829-38 taking down the church of Thennenbach, rebuilding it with a new tower at Freiburg, fifteen miles distant; 1832-6 the polytechnischeschule at Karlsruhe; the Protestant churches 1832-6 at Epfenbach; 1833-6 at Zaisenhausen; 1835-8 at Bauschlott; 1834 a design for a cathedral at Rotenburg; 1834-7 the Roman Catholic church having a nave and aisles with two towers, costing £3,460, at Burlach, a suburb of Karlsruhe, 140 (German) ft. long, 66 ft. wide, and 60 ft. high; 1836-9 the zollgebäude at Mannheim; 1837-8 the landesgestüt (breeding stables) at Karlsruhe; all these, with the churches for the villages of Dürheim, Rothweil, Stahringen, and Waitzen, are given in his *Bauwerke*, fol., Karlsruhe, 1838. Between 1836-40 he designed, after visiting 1837-8 Munich and Italy, the kunst-museum (new academy) at Karlsruhe; and, after visiting 1839 many of the German spas, the trinkhalle (pump-room) at Baden; and, after visiting 1846 England, the central strafanstalt at Bruchsal. He then published *Die Architektur und ihr verhältniss zur heutigen Malerei und Skulptur*, Stuttgart, 1847. His subsequent works were, after visiting Italy, the hoftheater 1851-3 for 2000 persons (intended to cost about £43,250, but reduced to half that expense by retaining parts of the old theatre); and 1853-8 the winter-garten at Karlsruhe; after visiting Vienna, the restoration 1854-8 of the cathedral at Speyer and the reconstruction of its west end, with the towers, and vorhalle or kaiserhalle (porch with statues of German emperors); the restoration of the cathedral at Constanze; the Roman Catholic church 1858-62 at Ludwigshafen (the freihafen or bonded warehouse there is attributed to him); the chapel of the nunnery at Bruchsal; a church with nave and aisles at Obersäckingen; an octagonal chapel at Badenweiler; a vaulted church at Bietigheim; the friedhofkapelle at Baden; with churches at Rheinbischofsheim, Kronau, Kandern, Emmendingen, Bühlerthal, and Altschuseyer, as well as churches partly erected at S. George, Oos, and Untergrömbach, with designs for two churches at Karlsruhe, which two, with that for Ludwigshafen, are shewn pl. 58-62 of his great work *Die altchristlichen Kirchen nach der Baudenkmale und ältern Beschreibungen, und der Einfluss des altchristlichen Baustyls auf den Kirchenbau aller spätern Perioden*, fol., Karlsruhe, 1858-62, with 63 plates. Some tracts, not including his *Architektonischen Verzierungen für Künstler und Handwerker*, fol., Frankfurt, 1823, and his *Entwurf zu einem Theater mit eiserner Dachrüstung*, fol., Frankfurt, 1825, are named in an anonymous memoir, which is an account of the works and opinions of this architect, whose reputation caused his advice to be sought 1852 upon the competition designs for the Bildersanstalt in Munich; 1854 upon the commission of inquiry into the cause of the fire at the government offices in Weisbaden; 1855 upon the design of a theatre in S. Gall, etc. He became 1837 knight, and 1858 commander, of the Lion of Baden; obtained 1855 the cross of the third class of the Red Eagle of Prussia; and 1858 that of the first class of S. Michael of Bavaria; he received 1850 the diploma of Ph.D. from Heidelberg; and 1853 the gold medal for art and science from the king of Württemberg; besides being a member 1846 of the academy of arts in Munich, and 1849 of that in Berlin, he was elected 1837 an honorary and corresponding member of the Royal Institute of British Architects. His death, which

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occurred 3 April 1863, was noticed in the *BUILDER Journal*, xxi, 441.

HUESCA. A city in the province of Aragon in Spain, situated on the river Isuela: parts of the old walls remain. It is well built, with wide, clean, and well paved streets and squares. The cathedral, consisting of a nave and aisles with chapels between the buttresses, was designed 1400 by J. de Olotzaga in the German Gothic style; after many interruptions, it was finished in 1515: the length is above 200 ft., the breadth a little less. The alabaster reredos, executed 1520-33 by D. Forment, a Valencian sculptor, is a very fine work, and cost 5,500 crowns (escudos) or libras jaquesas. The west doorway, stated by LLAGUNA to be by Olotzaga, STREET considers to be a work of cir. 1350; it has on each side fourteen full size statues on pedestals in niches; but the whole number of statues, including the smaller ones, is forty-eight; the entrance is surmounted with a kind of canopy in one stone, on which the architect made a careful model of the intended building; ANSA, *Historia de Huesca*, b. iv. The wooden doors are covered with iron plates beaten up into a pattern, and nailed on with large brass nails. The cloister on the north side is the principal remaining portion of the older church, but it is much damaged; a few tombs corbelled out from the walls, are of much interest. The plan of the cathedral is given by STREET, *Arch. of Spain*, 8vo., London, 1865, p. 364; who also gives that of S. Pedro el Viejo, cir. 1150, consecrated 1241, which has a nave and aisles of four bays, a transept, all waggon-vaulted, with a raised lantern over the crossing and three parallel apses at the east end; a hexagonal tower against the north wall of the north transept; and a cloister on the whole of the south side of the church; on the east side of the cloister is a series of chapels or rooms, of early date. The church is built of red sandstone, whitewashed throughout. STREET also notices the church of S. Martin, having a plain west doorway of the thirteenth century; and that of S. Juan, said to have been consecrated in 1204.

The plaza in front of the cathedral contains the palace of the kings of Aragon, which has a crypt called 'la campana del rey Monje', dating from "the end of the twelfth century" (STREET), but it is stated to have been in existence in 1136, in the reign of king Ramiro II; the college of Santiago; and the university, an octagonal structure designed 1690 by don F. de Artiga, having two ranges of columns, and in the interior a spacious court, also octagonal; with a portico consisting of disengaged columns and arches, leading to the different halls. The city also has six convents, several chapels, many schools, an hospital, town and session houses, two prisons, two theatres, a bull ring, and a barrack. Near Huesca, between two hills, is the *santano* or water reservoir, constructed by Artiga, in which the water from the river Isuela and the mountains is collected for the purpose of irrigation. 66.

HUET (MAÎTRE), see OUGUET.

HUGH of GRENOBLE, or of AVALON (SAINT), of a Burgundian family resident at Grenoble, was born in 1140, became a Carthusian monk, and governed the priory of Witham in Somersetshire, from whence king Henry II promoted him to the see of Lincoln in 1186, which he filled until his death in London 16 Nov. 1200; he was canonized in 1220. The cathedral having been rent from top to bottom by an earthquake in 1185, he "constructed anew the fabric from the foundation" (JOHN DE SCHALBY); and MATT. PARIS notices that it was his frequent custom to carry stone and mortar upon his shoulders to build the church. At his approaching death at the old Temple in London, he requests Gaufridus de NOÏERS, "nobilis fabricæ constructori, quam cepit a fundamentis in renovanda Lincolnensi ecclesia erigere Hugonis magnifica erga (not gracia) decorem domus dei dilectio"; MS. Life in the Bodleian library, Digby, 165, given in *ARCHITECTURAL SOCIETIES Reports and Papers*, 8vo., London, 1858, p. 17-39: Godfrey is thence presumed to have been Hugh's architect. He was to conclude

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all things for the adornment of the altar of S. John the Baptist, to be consecrated a few days later, and before whose altar he desired to be buried; this with the choir are the only portions asserted by actual records to have been completed in Hugh's time, although choir, transepts, and a part of the nave, including the vaulting to the west façade placed in front of the old Norman towers, are the portions built by him. This work, finished before 1200, is confirmed Early English; it is pure and perfect Gothic, with no Romanesque traces about it—it is the first great work accomplished in the fully developed Early English style (Peterborough nave being transitional). DIMOCK, *Metrical Life of S. Hugh, now first printed from MS. copies (dating 1235) in the British Museum and Bodleian Libraries*, 8vo., Lincoln, 1860; reviewed in the *GENTLEMAN'S MAGAZINE*, 1860, 459-66; 640: VIOLETT LE DUC, in a letter therein for June 1861, stated his opinion that the Early English portion of Lincoln cathedral is unique, being unlike anything he has seen in England or in France, but doubts the date; professor Willis grants the date, but considers the work to be French.

HUGHENDEN HEATH, see HEATH STONE.

HUGUET or HUET (MASTER), see OUGUET.

HUJET (GÉRARD) made the design for the mansion in the rue Neuve des petits Champs at Paris, at the expense of the marquis de Langlée; it was bought in 1708 by Claude le Bas of Montargis for 200,000 livres, and was occupied later by John Law, and others; in 1725 it belonged to the duc de Mazarin; BRICE, *Paris*, 8vo., Paris, 1725, i, 415. In 1770 it was known as the hôtel de Brunoy; it was pulled down in 1845; DALY, *Revue Générale*, vi, 46.

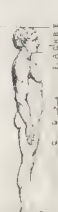
HULL. A building used in the West Riding of Yorkshire for the place in which turkeys, fowls, ducks, geese, or hogs are confined. When the animal or bird is to be fattened, the 'hull' is made dark and small, so that no exercise can be taken. *ARCHÆOLOGIA*, 1811, xvii, 149.

HULLYBEDU. A small mud fort in Mysore in India, with a suburb containing about eighty houses, situated on the side of a large tank, formerly the centre of a great city named Dorasamuda, the residence of several of the Belalla rayás, who once reigned over a great part of India. The site of the palace, in an inner fort, could be traced. It contains three Jain temples called 'busties'. The most remarkable building is a temple to Siva, erected by Vishnu Verdana raya before the year of Sal. 1203, or A.D. 1280-1; it is built entirely of 'balapum', a potstone impregnated with hornblende, which does not admit of a polish, "highly ornamented after the Hindu fashion, and larger than that at JAMAGULLU—some of the foliage possesses great neatness—it has gone far to decay; it much exceeds any Hindu building I have elsewhere seen—before the temple are two stone images of the bull of Siva, each about 16 ft. long, 10 ft. high, and 7 ft. broad, of a general black colour tinged with green—some of the pillars in the temple are of the same fine black hornblende used in Hyder's monument, and are highly polished; many of them reflect objects double; the knowledge of the quarries whence these materials were obtained is lost, but the natives believe that the stones were brought from Kasi, on the banks of the Ganges"; BUCHANAN, *Mysore*, etc., 4to., London, 1807, iii, p. 391-2; the pl. 27, gives an example of the ornamental scrollwork.

HULTZ or HÜLZ (HANS), see HILTS (HANS).

HULWUD, situated in the northern part of Kattyawar in Guzerat, India, contains a very ancient temple dedicated to Mahadeo, the third person of the Hindu triad, under his attribute of Regenerator. A well close by, is said to have cost fifteen lacs of rupees (then, 1813) about £180,000 sterling; which is not improbable, as in the Guzerat province, in the space of several hundred square miles together, not a stone is to be met with; FORBES, *Oriental Memoirs*, 4to., London, 1813, ii, 103. This temple is given in GRINDLAY, *Scenery*, etc., fol., London, 1826, pt. 1.

HUMAN FIGURE. The study of the human figure is generally considered to be of great service to the architect in designing, and also useful by giving facility of drawing. As this latter, however, is the direct purpose of the arts of painting and sculpture, reference must be made to special treatises for the rules, proportions, etc., and especially to those which teach the anatomy of the bones, muscles, etc. VITRUVIUS, iii, 1, has given some rules for the proportion of the human figure which it may not be out of place here to relate. He supposes the whole height to be the unit of measure. From the chin to the



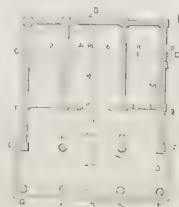
lowest roots of the hair on the forehead, A B, should be a tenth part of the whole figure. From the joint of the wrist to the tip of the middle finger, D C, the same. From the chin to the top of the head, A E, one-eighth. From the top of the breast (the sternum) to the roots of the hair, F B, one-sixth, to the top of the head, F E, one-fifth. From the chin to the lowest part of the nostrils, A G, one-third (i. e. of the face below the hair); from thence to the middle of the eyebrows, G H, the same; from thence to the roots of the hair, H B, the same. The length of the foot, one-sixth; that of the forearm, C I, one-fourth. The breast (i. e. from the navel to the sternum, F K) also a fourth. VITRUVIUS then notices that if a man were laid on his back and his arms extended (like S. Andrew's cross), a circle drawn from the navel would touch the ends of his fingers and toes; that if he stood upright with his arms horizontally extended, the tips of the fingers would be as far apart as his whole height; and the commentators add that if the figure be drawn in a square, the diagonals would cross at the point marked K. From this system of proportion, he states, arose the idea of deriving the proportion of columns and entablatures by certain divisions of the whole height. CARYATIDE; PERSÆ. A. A.

GWILT, *Encyclopædia*, s. v. Drawing, has given a concise description of the proportions, actions, centre of gravity, and motions under several cases, with illustrations, deserving the attention of the student. BONOMI, *Proportions of the Human Figure*, 8vo., London, 1856, gives the translation (1812) by WILKINS of the text of VITRUVIUS, amended from the Italian of L. DA VINCI, *Disegno*, Milano, 1830, and attributes the exposition of the proportions to the celebrated canon of Polyclethus.

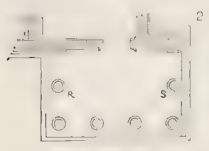
HUMBERT, archbishop of Lyon in France, is stated in the *Chronicles* to have made the design and conducted the erection 1050 of the stone bridge over the Saône, in that town; RAMÉE, *Hist. de l'Arch.*, 8vo., Paris, 1843, ii, 142.

HUMBIE QUARRY. A sandstone quarry situated at Humble in Linlithgowshire, about thirty miles from Glasgow. It furnishes a stone composed of fine quartz grains with siliceous cement, slightly calcareous; with mica chiefly in the planes of the beds. The colour is pale grey and light brown; it weighs 140 lbs. 3 ozs., and 135 lbs. 13 ozs. respectively, per cubic foot. The thickest bed is 8 ft.; and blocks of 90 cube ft. can be obtained, if required. This stone has been used at Newliston house; at Kirkliston; at Dundas castle; and at Edinburgh, in the additions to the royal institution; front of Surgeons' hall; spire of Tron church, 1828; and various other public buildings there and in Glasgow (as the exchange buildings): *Report of the Commissioners for selecting Stone*, etc., 1838.

HUMERUS. A word used by VITRUVIUS, iv, 7, in the chapter on TUSCAN TEMPLES. No satisfactory explanation has as yet been given of it. After describing the setting-out of the plan of these temples, he says that the outside columns of the portico O H, should range with the antæ E F; and the middle columns I K, with the division of the cellæ; the two middle columns LM between the antæ should also range in the same way. After

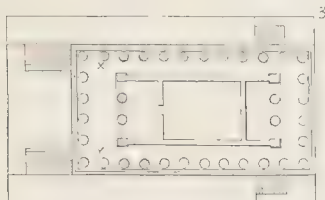


deducing from these data the proportion of the columns, etc., he goes on to describe a variety of these buildings, and says, "moreover temples are built of other kinds, the orders being of the same proportions, but having different arrangements, as that of Castor in the circus of Flaminius, and of Vejovis between the two groves [in the intermontium or space between the Capitol and the Tarpeian]; also, more skilfully, that of Diana in the grove [at Aricia (?)], columns being joined at the right and left sides to the shoulders (*humeros*) of the pronaos. In this way temples were at first built, as that of Castor in the circus; that at Athens in the citadel; and that of Minerva at Sunium." Now the only temple in the Acropolis which at all can be likened to the arrangement given above, is the Pan-



droseum, or what is more generally called the temple of Minerva Polias. This not only has four columns, R S, fig. 2, standing before the antæ, but its arrangement would quite suit the plan fig. 1, if two columns were inserted at N O. Of course in such

a case the four front columns, G, I, K, H, would be advanced forwards to make all the intercolumniations equal. The pronaos of the temple at Sunium is destroyed, but it will be seen by reference to the plan fig. 3, where the existing columns are



hatched, that there is room between the stylobate and cella for two such columns at the places marked x v. It seems clear that by the term *humerus* the antæ themselves are not meant, because VITRUVIUS uses the latter word frequently in the same chapter. The probability therefore is, that the walls R P, R Q, in fig. 1, projecting or shouldering forward, are the parts of the temple designated as *humeros*.

It has been supposed that *humerus* means the same thing as HARMOS, but it will be seen on reference that they are totally different.

HUMIDITY. That property of a substance by which it communicates to a body in contact with it, some of a liquid which it may have absorbed; and the term is commonly applied to the atmosphere when it is in a state capable of depositing moisture upon bodies it surrounds. The atmosphere often becomes humid from the evaporation of liquids by artificial means; vapours produced from liquids which are constantly in a state of ebullition, or simply from their evaporation, rise in the atmosphere, and even render it opaque; in this case the atmosphere is said to be humid, and it is capable of depositing excess of moisture that is in suspension, upon the bodies with which it comes in contact. The breathing of men and animals produces a watery vapour which renders the atmosphere humid; and when a number of persons are assembled in a close apartment, the humidity is sometimes so great that the atmosphere will condense on the cold walls and flow down as water. The effects of humidity on the dimensions of bodies are various; thus, when a watery vapour penetrates between the twisted fibres of cordage, which are vegetable materials, the cordage swells out transversely, and thus becomes shortened: while cords made of animal substances become relaxed, and increase in length. Most salts absorb water, and thereby increase in weight; taking advantage of this peculiarity, the salts of lime (chloride of calcium) are recommended to be placed in glass

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cases to absorb damp, thus preventing it resting upon any bright or valuable article therein. DAMP; MOISTURE. 14.

HUMULUS LUPULUS, the hop, has been treated by GRIF-FITH, *Arch. Botany*, &c., London, 1852, p. 6, as a plant fit for introduction into architectural decoration.

HUNALDUS, a young monk, was selected on account of his expertness in the arts, by William, abbot of Dijon, to assist in building the church of S. Benigne in that town, under the personal directions of the abbot, who laid the foundations in 1001; WHITTINGTON, *Hist. Survey*, 8vo., London, 1811, p. 49, 229, from D'ACHERY, *Spicilegium*; *Vetus Chron.*, Ab. S. Benig., fol., Paris, 1723, i, 434, 440.

HUNDRED AND HUNDREDWEIGHT. A term used in numbering and measuring various articles employed in building, but all materials, that can be so calculated, are now sold by the yard cube. In the thirteenth century lime was sold by the BAG as well as by the hundredweight; TURNER, *Dom. Arch.*, 1851, i, pref. xii. A hundred of fresh lime, round London, was 25 bushels Winchester striked measure (or 100 pecks), each bushel being sent in a BAG, but as the bag rarely contains a bushel, it may be assumed that one-twelfth of the quantity was not delivered. 30 and 32 bushels are called a hundred or a ton in some parts of the South of England; 35 bushels have also been called a hundred of lime. In Kent a waggon load, which should be 100 bushels, frequently measured not more than 70.

Under the old system lime was sold by the 100 heaped pecks, dry measure, which should have been 53,760 cubic inches, but by custom it was measured in a cube "a yard and an inch each way, making 50,653 cub. ins. This is less than the required quantity, while a cube of a yard and two inches would have been beyond the measure. It is now generally the custom that the yard cube should be accepted as the hundred of lime.

A. A.

A hundredweight of lead, etc., is equal to 112 lbs. avoirdupois; the long hundredweight is 120 lbs., so that the former is to the latter as .93333 to 1.

The term hundred is also given to pales and laths, six score of 4 ft. long pales; five score of 5 ft. long; and four score of 6 ft. long pales; LAXTON, *Price Book*. 56.

In timber yards, deals are sold by the long hundred or six score; thus the "standard" of deals is reckoned as 120—12 ft. 1½ in. by 11 ins., but varying lengths and thicknesses are imported.

| | No. | ft. long. | ins. thk. | wide. | Sup. ins. | Cube ft. |
|----------------------|-----|-----------|-----------|-------|-------------|----------|
| Petersburg deals | 120 | 12 | 1½ | 11 | 1950 of 1" | 165 |
| " battens | 120 | 12 | 2½ | 7 | ... | 175 |
| Dantzic deals | 120 | 12 | 1½ | 12 | ... | 180 |
| Norway " | 120 | 12 | 3 | 9 | 3240 | 270 |
| Sweden " | 120 | 14 | 3 | 9 | ... | 315 |
| Baltic deck deals | ... | 40 | 3 | ... | ... | ... |
| Christiania standard | 120 | 11 | 1½ | 9 | 1237½ of 1" | 103½ |
| Drammen | 120 | 9 | 2½ | 6½ | ... | ... |
| Ditto | 120 | 13 | 1½ | 9 | 1462 of 1" | 121½ |
| Quebec, long | 100 | 12 | 1½ | 11 | ... | ... |
| Ditto, short | 120 | 10 | 3 | 11 | 2750 of 1" | 229½ |
| London and Dublin | 120 | 12 | 3 | 9 | 3240 of 1" | 270 |

The measurements have been reduced to one standard of 12 ft. long, 3 ins. thick, and 9 ins. wide. Two of the latest works for calculating deals according to this, the Petersburg standard hundred, are, J. SMITH, *Companion to Hoppus*; *Hand-book of Tables for the use of Timber Merchants*, etc., London, 1860; and GRANDY, *Timber Importer's*, etc., *Standard Guide*, 8vo., London, 1865.

HUNG. A sash window is said to be single or double hung, when the upper half or both of the sashes are made to lift up and down. DOUBLE HUNG. A door is said to be hung when fixed on its hinges.

HUNGARIAN BLUE, see COBALT BLUE.

HUNT (THOMAS), clerk of the king's works temp. Edward IV, had "of the issues of his office xxxvii. xs., as noticed in the Harl. MSS. 433, fol. 311: 35b, shows that he was appointed to

the same office "for the term of his lyff": and fol. 24b, "during the king's pleasure with wages of iis. by day and vid. for his clerk", by Richard III, 1483. He appears to have died before 15 Dec. (1506) 22 Henry VII, when he was succeeded by H. Smyth; *Calendar of State Papers*, Henry VIII, i, 24, which, p. 932, shows that Hunt had the grant of the ferry of Sandford-hith, Oxon and Berks, and the care of the king's ferry boats.

HUNT (THOMAS F.), was amongst the earliest students of mediæval architecture, especially the Tudor phase. He designed the mausoleum of Burns at Dumfries, 5 June 1815; *ILLUSTRATED LONDON NEWS*, v, 389: and was one of the 'labourers in trust', or a clerk of the works attached to the Board of Works, at S. James's palace, etc., until 1828, when he was succeeded by S. Smirke, he himself being transferred to Kensington palace, where he died 4 Jan. 1831, aged forty years, and was succeeded by J. H. Good. He is best known by the following publications of designs: *Half-a-dozen Hints on Picturesque and Domestic Architecture*, 14 pl. 4to., 1825, 3rd edit. 1833; *Designs for Parsonage Houses, Almshouses, etc.*, 21 pl. 4to., 1827; *Architettura Campestre, displayed in Lodges, Gardeners' Houses, etc., in Modern or Italian Styles*, 12 pl. 4to., 1827; *Exemplars of Tudor Architecture, with illustrative details selected from Ancient Edifices, and Observations on the Furniture of the period*, 37 pl. 4to., 1830; and *Series of Designs for Gate Lodges, Gamekeepers' Cottages, and other Rural Residences*, 12 pl. 4to., 1836: these works have all had reissues.

HUNTERSHELL AND COLTMUIR QUARRY, together with the Crowhill, Milton, and Kenmuir quarries, all situated near Bishopbriggs or Bishopbridge, near Glasgow, Scotland, furnish, as "Scotch freestone", large supplies for building purposes in Ireland. The stone from the latter quarries was used at the new national practising schools, Lower Gardiner-street, Dublin; and at the new exchange at Dundalk.

HUNTING BOX. A building planned for the purpose of occasionally accommodating the owner during the hunting season, and his many guests, with conveniences for the domestics and the horses belonging to him, and to those friends; the dining-room, sleeping accommodation, and the stables, being the paramount features. When a kennel is added, the necessary establishment requires a structure which rises to the dignity of a HUNTING SEAT; a term applied to such a mansion as the Oaks at Banstead, which, as altered for the earl of Derby, provides fifty bedrooms for visitors. TATTERSALL, *Sporting Architecture*, 4to., London, 1841, notices the distribution of 'hunting stables'.

HUNTING TOWER. A lofty building erected on a suitable spot, such as the junction of several roads, from whence ladies who did not choose exercise, could see much of the progress of their friends who were engaged in a chase along avenues or over open country. Examples of such towers are said to have existed at Tibbermuir near Perth, and at Chatsworth.

HUON RIVER PINE, see DACKYDIUM Franklini, of Van Diemen's Land.

HUPEAU (. . .) was one of the king's architects at Paris, and ingénieur des ponts et chaussées. He began 1750 the bridge at Mantes, of three elliptic arches with a central span of 128 ft., finished after his death by Perronet; and another 1750-60 at Orleans about 1200 ft. in length, of nine elliptic arches, with a central span of 106 ft.; and submitted 1748 a design for the *carrefour* of the rue de Bussy at Paris, to receive the proposed statue of Louis XV. He became 1757 a member of the academy of architecture; and died 10 March 1763; PATTE, *Monumens*, fol., Paris, 1767, p. 9 and 207.

HURAM, see HIRAM.

HURDLE. A framework of stout sticks, intertwined with brushwood, bush boughs, or other rough forest stuff, resembling basket work, and used as fences, particularly for folding sheep. The outer rods representing the stiles of a gate are longer than the others, and are pointed, so as to hold in the ground when

driven by a heavy maul: they are then generally tied together at the top by a twisted withe. In Italy this species of hurdle, or as it is often called 'wattle', seems to have formed the core on which the large *dolia*, or huge earthen vessels for holding oil, were modelled. Of course when dry the whole was burnt, the core was dissipated by the fire, and the vessel remained converted into pottery.

A. A.

At a meeting of the Kilkenny Archæological Society, held 5 March 1851, E. N. HORE, M.A., dean of Waterford, described the crypt beneath the deanery house of that city, in which he stated that "a second vault hitherto used as a coal cellar—is curious, as containing in the roof large quantities of the hurdle, used for the centring of the (semicircular) arch in the original building of the edifice"; *BUILDER JOURNAL*, 1851, ix, 394, from the *Proceedings* of the Society, i, 413-5, which gives a view of the vault. It might be considered that a sort of rough hurdle bent to the curve formed a centre for the vaulting. The Roll of payments of Wages, etc., 37 Henry III, 1253, for works at Westminster abbey, names two dozen hurdles or crates with poles, as costing 9s. 7d.; WILLIS, in *GENTLEMAN'S MAGAZINE*, 1860. "Hurdles for scaffolds" at S. Stephen's chapel, occur 4 Edward III, etc.; with beams and poles, and leather thongs to tie the beams and hurdles together; BRAYLEY and BRITTON, *Palace*, etc., 8vo., London, 1837, pp. 151, 153. SMITH, *Antiq. of Westm.*, p. 182, and p. 184, has "twenty-four hurdles pro viis. super dictam scaffottam", which explains their use in lieu of plank as now employed; *BUILDER JOURNAL*, 1860, xviii, 654. Hurdles are even now occasionally used by country builders.

FLAKE.

Hurdles made of rods of iron passing through flat bars have for some years superseded those of wood in ornamental grounds; and of late years the continuous iron fencing formed of wire ropes, has taken the place of hurdles where such a protection is required to be constantly kept up; but both sorts require care, as well as protection from the weather by paint.

HURRICANE. The term given to air excited, by atmospheric influences, with a very great velocity, and consequently exerting a very powerful force against all objects obstructing its course. This is noted s. v. *ÆRODYNAMICS*, and *FORCE OF THE WIND*. In places where buildings are subject to hurricanes, the whole of the roof should be fixed down to the wall plate, and the wall plate to the wall; and the latter made strong enough to resist the powerful current of air that may rush against the house. Where buildings are of wood, the framework should be tied into the ground, or into stone piers fixed in the ground. On 11 Aug. 1831, during the hurricane at Barbadoes (*GENTLEMAN'S MAGAZINE*, ci, pt. 2, 361), buildings having substantial partitions at short intervals withstood the blast, whilst others without them were blown down; inside buttresses would answer the purpose. Shutters should be made to open on pivots at top and bottom; joists for galleries or verandahs, when let into the wall, tend to upset it; the brickwork should be English bond grouted throughout, the bricks having been saturated with water; four parts of sand, carefully selected, to one of coral lime, makes very good mortar and sets very strong. A small building arched like a gunpowder magazine was uninjured; an hospital building well tied with iron also withstood the storm. The roofs when reconstructed had diagonal bracing inserted to stiffen the rafters; parapet walls were found to protect them; flat roofs, such as those used in the Mauritius, are perhaps the best; Description abridged from *CORPS OF ROYAL ENGINEERS, Papers*, etc., new ser., 8vo., Lond., 1851, i, p. 120-1.

HURRIES. The term, applied in some places to the stages of wood on navigable rivers, harbours, etc., to which the railways are conducted from coal pits.

2.

HURST. The Saxon term for a wood or grove, frequently used alone, but more often as an affix in the names of places, as still appears in those of Hazlehurst, Penshurst, etc.; and as a prefix in Hurstmonceaux, and the like.

19.

HURST (WILLIAM), F.I.B.A., born in 1787, was extensively employed in the counties of York and Nottingham. He was a native of Doncaster, and was articled to Mr. Linley of that town. He afterwards joined the firm of Linley and Woodhead; subsequently the firm of Woodhead and Hurst designed 9 Oct. 1827, consecrated 10 Sept. 1829, Christ church in that town, a building which was said to be very much in advance of the times; and S. George's church, Sheffield. On the death of Mr. Woodhead, the firm W. Hurst and W. L. Moffatt (from 1835) designed 1840 the Ship hotel and Westgate improvements, Rotherham; 1841 S. Peter's church, Rock Park, Cheshire; cir. 1841 Rawcliffe new church; cir. 1844 S. John's church at Goole; with many public buildings in Leeds and Wakefield, principally by Mr. Moffatt; and finished May 1844 the Clipstone archway in the great drive from Welbeck, for the duke of Portland. Engravings of the above works are in the library of the Royal Institute of British Architects. The *SURVEYOR*, etc., *Journal*, 1843, iv, 197, gives the proposed market at Doncaster. Hurst died 8 December 1844, aged 57 years. The name of "Mr. Hurst, Archt." appears in MALTON, *London and Westminster*, fol., 1792.

HURTADO DE LUNA, laid 1508 the first stone for the parish church at Irun, in the province of Guipuzcoa in Spain; it is built entirely of squared stone, and is one of the most sumptuous edifices in the country. 66.

HURTADO IZQUIERDO (DON FRANCISCO), *maestro mayor* of Madrid, about 1725 designed the chapel del sagrario of the Carthusians del Paular; the cupola was painted by Palomino: he made also another similar sagrario for the Carthusians at Granada; and 1700 the sacristy or chapel of the cardinal of Salazar in the cathedral church of Cordoba. He is said to have been the inventor of a style, like his contemporary Churriguera. 66.

HURTAULT (MAXIMILIEN JOSEPH), sometimes printed Hertault and Hurtault, was born 1765 at Huninguen, in the department Haut Rhin. He was a pupil of Mique, and was for a long time employed in a subordinate sphere at the château de Trianon. After the Revolution he became architect-inspector of the halls of the conseil des Anciens, and of the conseil des Cinq Cents. He directed, upon the designs of Percier and Fontaine, the restoration and decoration of the chapel, the theatre, and the apartments of the Tuileries. In 1797 he obtained in competition the second *grand prix* of the academy, for a public granary (given in VAUDOUYER, *Projets d'Arch.*, etc., fol., Paris, 1805, pl. 53-4); and in 1798 competed for the *grand prix*, a 'bourse maritime' (given in DETOURNELLE, *Recueil*, 1805, pl. 31-3), which also gives, pl. 26-7, his design for a monument to general Desaix, in 1801; it is also given in DETOURNELLE, *Arch. Nouvelle*, 4to., Paris, 1805. He then went to Italy, whence he returned with a great many studies of buildings and monuments. He erected a great number of hotels and private houses at Paris, including his own residence in the rue Richepance, and the riding school in the rue S. Honoré. Being appointed royal architect of the château de Fontainebleau, he restored the gallery of Diana, and the "cascades du Tibre", and designed the fountain of Diana in the park, the pavillon de l'étang, with its garden, and the chapel in the forest. In 1819 he exhibited a design made for the préfet of the Seine for a monumental fountain to be erected on the boulevard Bonne Nouvelle. His last work as director of the works at the château de S. Cloud, was the plan for the beautiful garden reserved in the park for the duc de Bordeaux; and in 1823 he designed the marché et salle de réunion publique at Joigny (Yonne), given in GOURLIER, etc., *Choix d'édifices*, etc., fol., Paris, 1825-50, i, pl. 5-6. Hurtault did the little pavilions of the grille de Sèvres at S. Cloud, the house of the passage Sandrié, a *manège* in the rue S. Honoré, an hotel in the rue de Paix. A catalogue of his library is printed. He was 1816 professor at the académie des Beaux Arts; inspector-general for the conseil des bâtiments civils; and 1819 a member of the

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Institut. He died at Paris 2 May 1824 (not 1825 as often stated) in the 69th year of his age. 68. 110. 112. 113.

HUSDORF (HANS) built 1478-1501 the (south) Martins-thurm of the münster at Basle. 92.

HUSK. The point, **V** or **A** in shape, forming a supposed germ from which curvilinear decoration originates, as the petals of a flower start from the cup. It has been calculated that the Greek, Roman, and Arabesque, ornament together possess about eighty-four of these starting points, each having its particular name, character, and use. Such are the lily, or husk properly so called, the lily head, the convolvulus head, the woodbine head, the crocus head, the bell head; these are merely variations in form of the main notion, and have received a conventional title; they have each an appropriate cup and an upper or smaller head or husk.

HUSLY (JACOB OTTEN), *baumeister*, born in Germany, was also a sculptor. He was professor of the drawing academy at Amsterdam, where he instructed the students in architecture. He designed the town halls of Groningen, Leeuwarden, and Weesp; and 1789 gained great reputation for the house for the Institute of Fine Arts and Sciences, Felix Meritis, at Amsterdam, of which he was director (plans and an elevation are given in GOETHEBUER, *Choix des Monumens*, fol., Ghent, 1827, p. 4, pl. 5-6. He published *Op het vertoonen der Nieuwe Hof-zal op den Amsterdam'schen Schouwburg*, 8vo., Amst., 1766. He died 1795 at Oosterholt near Kampen, in consequence of breaking his leg by a fall. 24. 68. 116.

HUSTINGS. A local court in the Saxon period was called *hustinge*, and under the title of "the court of hustings", the supreme court is still held in the city of London. The term is, with this exception, now applied to the erection in which votes are taken at the election of members of parliament. The modern hustings is generally a timber structure specially put up in the middle of a large open space for the purposes of the election, and removed as soon as it is over. The hustings should be designed upon the principle of centralising the supervision or power of the local authority, and dividing the excited crowd of persons taking part in an election. The requirements of a hustings are threefold, and can be best arranged thus: 1, an office on the ground floor for the returning officer; 2, a rostrum over the office for the delivery of speeches by candidates and their supporters; 3, polling booths placed back to back, with a central passage having an elevated floor, connected with the office. Each polling booth must have desks and seats approached from the central passage, to accommodate about seven persons, in two rows, to receive and check the votes. Gates or lifting bars to each polling booth must be provided on the sides next the open space, for the entrance and exit of voters. Strong barriers must be fixed, as matters of police, to divide the mob and prevent interference with, and pressure upon, the voters. The building must have a waterproof roof; as glass windows are likely to be broken, they should, therefore, be used sparingly; sunshades or wind-screens of canvas should be fixed, and the aspect of the rostrum determined, as the locality, period of the year, or state of the weather, may necessitate. R. R. R.

HUT. This word, in its precise signification means a wigwam, conical in form, and made of branches of trees fixed at one end into the ground and tied in a bunch at the other extremity: such was formerly used as a substitute for a tent by agricultural labourers during harvest, by shepherds and goat-herds in open country, and by soldiers who halted for a night out of a village or town. If intended to be more than a temporary contrivance, it was covered with earth, boughs, or straw. The *gurbies*, or huts, of the Berbers, Kabyles, and native tribes inhabiting the whole chain of the Lesser Atlas from Tunis to Morocco, "are generally raised with hurdles daubed over with mud, or else they are built out of the materials of some adjacent ruin, or with square cakes of clay baked in the sun. They seldom exceed 10 ft. in height, are entered

C C

through a low and narrow door, and for windows have small holes in the wall, rarely furnished with a piece of glass. The whole interior forms but one room, a corner of which is allotted to the fowls, calves, and kids. Sometimes four or five of these huts are built together, enclosing a square courtyard into which they all open. That through which entrance is obtained to the courtyard is generally formed into two rows of stalls, with a passage between them: the others serve as habitations for the family, and storehouses for the crops"; LORR, *Algiers*, 8vo., London, 1835, i, 167. Such a building is not very unlike the wigwam made by the Indians of North America: this is described as being 9 or 10 ft. high, made with poles fixed into the ground and brought together round a hole or chimney in the middle of the top; the outside covered with boughs, or with wattles and bark; and the inside finished with a bank of earth round the woodwork: PHIL. TRANS., 1676, xi, p. 632.

The hut is distinguished from the CABIN by not having the regular roof which marks the latter: the term 'hut' is now applied to any very small cottage, being the humblest dwelling of the peasant. The original meaning of the word is preserved in the term 'garden-huts' applied to bowers or rustic arbours: the COSSACK-HUT, DUTCH-HUT, and POLISH-HUT, are rather cabins than huts; and the same remark applies to the log-cabin, rough-log-shanty, and slab-hut, which are mentioned as corresponding with the log-hut or log-house, in the BUILDING NEWS Journal, 1856, ii, 634, where several details of materials, cost, etc., are given. The AIDE MEMOIRE, 8vo., London, 1846, ii, s. v. Castrametation, notices many varieties; and in the same work, s. v. Hut, the log-hut, the framed-hut, the framed-hut lined with brick, the pisé-hut, and the hut of rubble masonry with clay or lime mortar, are separately described.

The logs for a room 15 ft. by 10 ft, which is the size commonly adopted in a primitive settlement, are of spruce or fir, 8 ins. in diameter, with the bark taken (generally) off, and the angle joints formed by halving the logs and pinning them together; the joints are made weather tight by a stuffing of clay, wattles, sawdust, or small branches of soft wood, "and these joints are then lined with laths, or the whole interior boarded if inch boards can be had, which is preferable." This building, without sashes, it is assumed can be erected by two men in one week. Another mode of construction consists in the use of squared logs dovetailed or halved together, and fastened with wooden pins. These huts are often 'clap-boarded', i. e. faced with $\frac{3}{4}$ in. thick featheredged weather boards on the outside.

A Report of the Canadian House of Assembly on Railways, 1856, states that a settler on a free grant of land is required, amongst other things, to build a log-house at least 20 ft. by 18 ft.; that such a house can be easily put up in four days by five men; the roof can be covered with bark, and the spaces between the logs plastered with clay and whitewashed: it then becomes a neat dwelling, and as warm as a stone house. The cost of a log-house of this description, where hired labour is employed, does not exceed £12:10:0. The wooden huts, of various sorts, supplied to the army in the Crimea, are described in the BUILDER Journal, 1855, xiii, 431, 443; and p. 634 were severely criticised: at p. 154 the size and weight are given of the huts invented by J. R. Isaac for transport. The iron houses made by Bellhouse and Co. for emigrants to California, are given in the ALLG. BAUZEITUNG, 1850, pl. 342.

HUTCHINSON'S patent for INDURATING STONE. This process, patented by W. Hutchinson in 1847, No. 11,979, is founded on the rapidity with which sandstone will absorb a mixture of pitch, tar, resin, or any other similar oleaginous substance, when applied in a boiling state; and an attempt has been made in consequence to apply it chiefly to the CALVERLEY or Tunbridge stone, which is a very soft, friable, description of sandstone, and so render it better adapted to resist the effects of the atmosphere. It must be remembered that the substances introduced for the induration are themselves susceptible of

oxidation, and consequently of gradual removal. It is found, in fact, that however much the hardness of the Tunbridge stone may be increased by this process in the beginning, it will ultimately yield to the attacks of the atmosphere when exposed to their influence for a long period, say of from six to ten years. The disagreeable dark colour that is left in the stone which has been subjected to it, is also an objection to the application of this process. The patent, with testimonials from Sir R. Murchison, are given in *Transactions of the Royal Institute of British Architects*, 1860-I, p. 148-9.

G. R. B.
HUTOR. The name given to a suburban villa at Odessa, and also at Warsaw; the former are on the sea-shore; every walk is overhung with the acacia, which is almost the only tree that can be brought to thrive in that country; BREMNER, *Russia*, 8vo., London, 1839, ii, 499.

HUVÉ (JEAN JACQUES), born in June 1742 at Boivinliers in France, was a pupil of Blondel, and 1764 inspector of the buildings at the mint. He obtained 1770 the *grand prix* of the academy; travelled through Greece and Italy, building a remarkably bold and strong bridge near Etua for the prince of Biscari; returned 1776, and was appointed inspector of the château de Versailles. KRAFFT, *Arch. Civile*, fol., Paris, 1812, new ed., gives, pl. 7, the château in Picardy, executed in 1780, of the president d'Hormois; and pl. 13, Huvé's house 'au bas de Meudon', on the Rhine. In his *Plans des plus beaux jardins*, etc., fol., Paris, 1810, he gives, ii, pl. 1, the president "Harnois's" garden, executed 1786. He became *maire* of Versailles in the first years (1789-91) of the Revolution; and died 24 May 1808. 112. 116.

HUVÉ (JEAN JACQUES MARIE), born 28 April 1783 at Versailles in France, first studied under his father, afterwards under Percier. In 1808 he obtained two medals at the academy for two designs for the same subject; and also a third medal; he likewise obtained the prize in competition for a theatre at Tours. Having from 1808, first as subinspector, afterwards as inspector, assisted Vignon at the church of Ste. Madeleine in Paris, he in 1828 succeeded him as architect, and felt bound to follow the designs of his master; the building was completed in 1843; plans, etc., in GOURLIER, *Choix*, etc., fol., Paris, 1825-50, ii, pl. 296-7, 301-2; the wrought iron roof covered with copper plates, by Huvé, span 59 ft., is given in BUILDER Journal, 1850, viii, 40. He completed 1819-21 the château de S. Ouen for the government, as a memorial of the return of Louis XVIII; 1824-6 the *marché aux vaches* grasses at Paris, at a cost of 21,000 fr., given in GOURLIER, i, pl. 45; and succeeded 1823 Viel at the hospice de Larochehoucauld at Montrouge, near Paris, given in GOURLIER, iii, pl. 40-1; and in NORMAND, *Paris Moderne*, 4to., Liège, 1846, pl. 101-2. Between 1820 and 1830, as architect des hospices, he made many restorations,—at the Hôtel Dieu; la Salpêtrière; des Incurables (femmes); des Ménages; de la Pitié; and des enfans malades et de Necker; with a design for an amphitheatre for the hospitals, etc., some of which are noticed in HUSSON, *Étude sur les Hôpitaux*, 4to., Paris, 1862, p. 43, etc. He also made many designs 1827 for the enlargement of the hôtel des postes, being appointed architect to the administration of that department; the successful design 1827-9 in competition for the opera comique in the place Ventadour, replacing the salle Feydeau; and made designs for a hospital at Cherbourg, and for improvements at that place, and at Versailles. Until the Revolution of 1830 he held the appointment of architect to the king, and to the château de Compiègne. In 1835 he was appointed chevalier of the Legion of Honour; and in 1846 officier. In 1837 named honorary member of the conseil général des bâtimens civils; 1838 elected member of the Institut; and in 1847 obtained the royal order of the Red Eagle of Prussia, third class. He died 22 Nov. 1852 at Paris, aged 69 years. DALY, *Revue Générale*, xi, 42; COTTA, *Kunstblatt*, 1839, p. 24; 1847, p. 192; LENORMAND, *Notice Biographique*, 8vo., Paris, 1853. 110. 112. 113. 116.

HUYGENSZ (KLAES) was one of the architects 1449 of the town hall at Gouda. *ÆLBRECHTS*. 24.

HUYOT (JEAN NICOLAS), born 25 December 1780 at Paris. He studied and practised under his father, who was also an architect, but when preparing for examination for the école polytechnique, he entered the studio of the painter David; some years afterwards he studied architecture under the younger Peyre. In 1807 he competed for and obtained the *grand prix* of architecture at the école des beaux arts, and went to Rome, where he was engaged in making a restoration of the temple of Fortune at Palestrina, the ancient Præneste; after a sojourn of six years in Italy, he returned to France in 1813. Bruyère, then director of public works, appointed him a sub-inspector; but, little satisfied with that employment, he 1817 went with count Forbin on his scientific voyage to the East, leaving his school and office under the care of Guenepin. Disembarking soon after at Milo, Huyot in visiting the ruins broke his leg, and was sent to Smyrna, where during his protracted convalescence he prepared for an intended journey to Asia Minor, and designed many buildings for Smyrna, such as the consulate, the restoration of the hospital for French mariners, etc. He visited the ruins of Tantalus, where he discovered many Pelagic walls, explored the constructions on Mount Sipylus, drew the plan of Smyrna, the famous temple of Æsculapius, and the monument erected to Homer; he then proceeded to Ephesus; thence to Constantinople, on the route drawing the ruins of Assos. At Constantinople he made designs for the completion of the palais de France, and the drawings for a hospital which was commenced before he left for Egypt. At Thebes he drew the greater part of the monuments; he ascended the Nile as far as the second cataract; and drew the monuments of Nubia, classifying them chronologically. On his return to Cairo, he was invited by the pacha to give his advice upon the work of the canal, from the Nile to Alexandria, then in progress of construction. He surveyed the whole line, and succeeded in removing one of the greatest obstacles, that of the filtration of the waters of the lakes Mariout and Madieh through moving sands. He left Alexandria to proceed to Asia Minor, and at Smyrna was joined by his countryman Dedreux, and by T. L. Donaldson, who at the time were in Athens. The whole party went to Ephesus, Priene, Cnidus, Halicarnassus, Mylassa, Stratoniceia, Pergamus, Tralles, and by way of Smyrna to Athens. Here he stayed one year, and made the plan of the city, together with its long walls, the three ports, and monuments of the city and of the acropolis. Afterwards he explored Bœotia and Attica, and prepared for a visit to Peloponnesus, when the Greek Revolution compelled him to leave for Italy; he remained one year in Rome, and made a general plan of that city and of its monuments.

On his return to France he was appointed lecturer on the history of architecture at the école des beaux arts; and succeeded Heurtier, on his death in 1822, as member of the académie des beaux arts. About the same period he was directed by the minister to make a design for completing the arc de triomphe at the barrière de l'Étoile. One of his projects, consisting of an addition of four engaged columns surmounted by attics, was approved by the conseil des bâtiments civils; but the minister preferring to keep to the original design by Chalgrin, the works proceeded under Goust, but from 1828 Huyot superintended the execution of the entablature, and of the caissons of the arches, until the Revolution of 1830: he was succeeded 1832 by A. Blouet; GOURLIER, etc., *Choix d'édifices*, etc., fol., Paris, 1825-50, ii, 242-7. Previously the calvaire du Mont-Valérien was executed by Huyot, who made the designs for a church of S. Charles, afterwards superseded by that of Ste. Clotilde. The salle du Tribunal, by C. E. BEAUMONT, has been attributed to Huyot, who in 1836 was directed by the government to design the enlargement of the *palais de justice*, in which he was succeeded by — Duc. The *SOUVENIRS DE PARIS*, fol., Paris, 1836, contains an in-

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teresting report by Huyot on the restorations at S. Germain des Prés. J. L. V. Grisart was one of his many pupils. He died at Paris 2 (3rd is stated in DALY, *Revue Générale*, i, 487) August 1840. VAUDOYER, *Notice nérologique* (MS.), fol., 1840; and *Catalogue des livres sur l'arch. et les antiq. du Cabinet*, 8vo., Paris, 1841, both in the library of the Royal Institute of British Architects. 68. 112. 113. 117.

HUYSMAN (. . .), architect at Antwerp before 1648, was father of Cornelius Huysman, the painter. 62.

HUYSENS (PÈRE PETER), a lay-brother of the order of Jesuits, and architect at Brügge, Belgium. He is stated by LECOMTE to have designed 1614-5 the church of S. Carlo Borromeo belonging to the Jesuits' college at Antwerp, burnt by lightning 18 July 1718; perhaps because his name occurs as the draughtsman of a view engraved by J. de la Barre: but the statement of HENSCHENIUS and PÉRIÈS cited by the COMMISSION ROYALE D'HISTOIRE, *Bulletins*, 8vo., Brussels, 1848-9, xiv, 63, xv, 120, might be held as sufficient evidence that the *maison-professe* was designed by Aguilan, and the church by Rubens; the design of the whole edifice is attributed to the latter, whose drawing for the front of the church existed 1763 in the library of the college. 69. 116.

HUYVETTER (JEAN BAPTISTE), born at Ghent, from his youth excelled in the theory of architecture, which he taught for forty years in the academy there, counting among his pupils J. B. Pisson, P. de Broe, P. Reyniers, J. Aelbroeck, and P. Colyn of Courtray; *REVUE DE BRUXELLES*, 12mo., Brussels, 1837, iv, 16.

HYACINTH RED. The name given to a red colour combined with yellow and a little brown, by ANSTED, *Elementary Course*, 8vo., London, 1850, who gives the hyacinth and the garnet as a standard.

HYALOSTROTUM OPUS. A term suggested, by PHILANDRUS, in a note upon VITRUVIUS, iv, 6, as the Latin expression to be used by an author writing upon glass-mosaic work.

HYAWABALLI. A tree of British Guiana, obtained from the river Demerara in the West Indies. It has a close grained, fine, hard, and heavy wood, about 8 ins. in diameter, which, known as *zebra wood*, is used for furniture, and is very scarce. 71.

HYDERABAD, originally called Bhaug-nuggur, and founded 1556, is now the capital of the Decan, and of the territory of the nizam, in southern India. It was formerly the capital of a kingdom destroyed by Aurungzebe at the close of the seventeenth century, of whom it was rendered independent by his viceroy, Azof Jah, better known as nizamool-Moolk, about 1724. It is situate on the south side of the river Mussi, and has a stone wall of weak construction: it is about two and three-quarter miles long on the river side, and about seven and a-half miles in circuit, with a considerable suburb on the left side, in which is situate the British Residency, begun 1803 (but not completed in 1813) "from the design and under the superintendence of S. Russell, a son of the Royal Academician, and then an officer in the Madras Engineers"; it is a fine structure of the Corinthian order, as shown in GRINDLAY, *Scenery*, etc., fol., London, 1826, ii, pt. iv. Communication with the palace is obtained by a bridge 24 ft. wide, planned and executed by a British officer in 1831, with eight elliptic arches of sienite, each of 56 ft. span and 18 ft. rise, with piers 10 ft. wide; on the left, or northern side, is a land arch 77 ft. span, and 16 ft. rise; the total cost was £10,200. The city is crowded with buildings of all descriptions, from palaces to the low and dirty wooden hovels of the poor; the former are erected in the native style, without taste, and too close to each other to be healthy: the streets are generally narrow, crooked, and badly paved with stone. Water is obtained from the river and from numerous wells. Besides the *mahal* or palace of the nizam, a native structure, and which, including the *zenana*, is several miles in circuit, and the residency, there is only the principal mosque (out of a considerable number) worthy of notice. This is said to have been built

on the same plan as that at Mecca; it has two very high domes, as also are the pillars, of polished granite: in front is a tank, and near it, the mausoleum of coarse marble very artificially cut, of the mother of the nizām Ali Khan.

In the environs are many fine gardens, containing gorgeous pavilions; among them, that of the minister (1858) of the nizām is represented as marvellously beautiful for its fountains, galleries, terraces, trees, paintings, gilding, etc. (THORNTON, *Gazetteer*.) Probably among them are "some ancient buildings, west of the city, the beautiful enamelled surfaces of which have hitherto braved the vicissitudes of the weather; the colours, blues, yellow, red, etc., are all very bright, and look as fresh as if they had been put on yesterday: the art of doing this is said to be lost", as noticed by HEYNE, *Tracts on India*, 4to., London, 1814, p. 272. GOLCONDA is situated six miles west of the city on the road to Poona.

About four (three) miles northwards is a large tank for rain water, called the Hussan Sagar (three miles in length and two in breadth); the eastern bank is the only one elevated or constructed; it is nearly a mile and a-half long, and in places that require particular strength it is 120 ft. broad, the usual breadth being not more than 30 ft. to 40 ft. The waterside is nearly perpendicular, and constructed of regular cut stones of granite; each of the two large sluices has three stories, with steps down to the water, all built with large square blocks of granite (HEYNE, p. 262-7). Another tank is said to be twenty miles in circuit.

HYDERABAD or HYDRABAD, erected nearly on the site of the ancient Nerunkot, by Futteh Ali, the first ameer of Scinde, north of Hindostan, was formerly considered the principal town of that country. It is situated four miles east of the river Indus, on a rocky eminence about 200 ft. high, in an island between it and the Fulailu. The walls, 30 ft. to 40 ft. in height, built of burnt bricks, are weakened by embrasures and loopholes, and flanked by round towers or lofty bastions at intervals of 300 or 400 paces; a ditch, about 10 feet wide and 8 feet deep, occurs in portions. The houses are of mud. The fortress contained the residence of the ameer, a square brick building, inlaid with coloured tiles, and a massive tower built for their treasures. The bazaar is extensive, forming one street the entire length of the town. A cemetery on the northern part of the eminence, contains the tombs of the members of the Talpoor dynasty, and of the preceding one of the Kaloras; that of Gholam Shah Kalora is a fine quadrangular building, with a central dome, and lined with marble ornamented with mosaic and inscriptions; that of the late ameer, Kurum Ali, is of the same form with a turret at each angle. The British residence, situate near the Indus, about three miles from the city, in the grounds of a former ameer, is said to have been erected from a plan by (the then) major Outram; it was destroyed during the insurrection of the ameer in Feb. 1843, but was only a small building, as shown in the *ILLUSTRATED LONDON NEWS Journal*, 1843, ii, 254. THORNTON, *Gazetteer*.

HYDRA. A fabulous monster, said to have infested the lake Lerna, and to have been slain by Hercules as one of his celebrated labours. It is sometimes represented in decoration as a large snake with a number of heads branching from one neck. Like most of the Grecian emblems, it seems typical; for as the lion represents courage, and the griffin rapacity, so the hydra is the emblem of faction and popular tumult. A. A.

HYDRATE. The chemical combination of a solid body, such as an earthy or mineral base, with water in definite proportions, yet the body still retaining the solid form. It differs from the water of crystallization in this respect, that the latter contributes to the regularity and to the translucency of the subjects with which it is combined; whereas water, that simply suffices to hydrate the subject in combination, does not enable it to assume the peculiar characteristics of crystallization. The number of hydrates that are known is very considerable; such

are the hydrate of lime, alumina, baryta, cobalt, potash, copper, magnesia, soda, etc. Of these, the architect has principally to occupy himself with the hydrate of lime: the hydrous compounds, in conjunction with other acids, are very numerous, and well worth study. When water is added to quicklime, it is absorbed, a greater or less amount of heat being evolved during the process, and the lime then passes into the state of a hydrate, which assumes a concrete form, with more or less approach to the crystalline state in proportion to the capacity that the lime may have to become a body of that form, and by the gradual absorption of carbonic acid gas from the atmosphere. The process of hardening that ensues upon hydration is the most important part of the theory of limes and cements. G. R. B.

HYDRAULIC CONCRETE; see HYDRAULIC MORTAR.

HYDRAULIC ENGINEERING. That branch of civil engineering which is confined exclusively to the execution of works required either to conduct, to contain, to distribute, to direct, or to resist water, the action of it, in its various states. The complicated nature of the forces concerned, and of the chemical actions, which at times come under the notice of the hydraulic engineer, render this one of the most difficult, as well as one of the most important, branches of the professions of construction. He is often required to enclose lands from the sea; to protect exposed shores; to resist the destructive action of littoral currents; to form artificial roads by the erection of breakwaters or jetties; to build harbours, docks, and canals; to improve the courses of rivers; to protect their banks and regularize their depth of water; to collect, store, filter, and distribute, water required for domestic purposes; to form wells; to drain lands; to sewer towns, and to dispose of the sewerage when it has been collected; to build bridges, aqueducts, and syphons; to lay down courses for water wheels, even when the details of the wheels are left to the care of the mechanical engineer; and to design works for irrigation of meadow, rice, or garden, lands. Effectually to discharge the duties of such a profession, there is in fact hardly any branch of applied science which must not be pressed into the service of the engineer; and, as might naturally be expected, the leading members of the scientific world have all in their turn directed their attention to the study of some detail or other connected with his pursuit. Such names as Galileo, Frisi, Guglielmini, Michelotti, Borda, Belidor, Perrenet, Lamblardie, De Cessart, Cachin, Navier, Poncelet, Bossut, De Prony, D'Aubuisson, Euler, Eytelwein, Brünnings, Wiebeking, Smeaton, Watt, Robison, Leslie, Playfair, the Rennies, Telford, Dwyer, Neville, Provis, Hawksley, Wicksteed, and many others, will be found amongst the illustrious labourers in this inexhaustible field. Architects may occasionally have to perform some of the works enumerated above as constituting the ordinary occupation of the hydraulic engineer: as for instance, the construction of bridges; the erection of quay walls; the sinking of wells; the drainage and sewerage of houses; the internal distribution of a water supply; and such like works. G. R. B.

HYDRAULIC JAR, or SHOCK. The sudden jar produced in a pipe by the interruption of the discharge. It is proportionate to the effective head, that may exist upon the column of water at the point of discharge, and it requires to be taken seriously into account in considering the service of a water supply. The hydraulic jar will very often entirely dislocate the service pipes, if the provision be not made by carrying the pipe some little distance beyond the tap. On suddenly shutting a tap, a concussion is felt, and the pipe is shaken with a noise resembling the fall of a piece of metal within it. Where a fall is obtained, a common kind of HYDRAULIC RAM may be made by joining behind the tap a small pipe, which, if carried up, will be found to prevent the jar, and to convey the surplus water up to a height much beyond that at which the cistern or supply is situated, and form a new water-service, to a small

extent certainly, but one raised without trouble or exertion every time the tap is turned. This fact was discovered at Bristol before Montgolfier's invention, as noticed in ACKERMANN, *Repository*, etc., 8vo., London, xi, 1821, p. 142. G. R. B.

HYDRAULIC LIFT, see DERRICK; JACK; HOIST; and LIFT.

HYDRAULIC LIME. The term hydraulic is generally applied to any lime which possesses the quality of setting under water. Various limes have this power in different proportions, hence their classification of the feebly, the moderately, and the eminently, hydraulic limes. It is necessary to direct attention to the distinction that prevails between the eminently hydraulic limes and the cements, which have been already noticed *s.v.* CALCAREOUS CEMENT.

VICAT was the first person to propose the distinction between hydraulic, and non-hydraulic, limes; he was also the first person to discover upon what it depended; this he obtained both analytically and synthetically, and thus at once placed the theory of limes upon a sound basis. SMEATON, and some of the earlier observers, had noticed that when limestone contains naturally a proportion of clay, or when the latter is added to it after slacking, it acquires hydraulic powers; but there remained a great degree of uncertainty about the question as to what ingredients were necessary to produce this effect; some persons attributing it to the silica, some to the iron, or to the magnesia, that was present. VICAT, however, ascertained that a certain proportion of silicate of alumina is always in combination with the carbonate of lime possessing the power of hardening under water; and he proved that it is to this fact that the lime is indebted for this property, by uniting the pure carbonate of lime with the different proportions of clay that were required to produce the different rates of setting under water. Subsequent experiments have confirmed the deductions which VICAT then drew from the phenomena he observed; and at the present day these explanations are admitted without dispute. He found that the limes having a proportion of silicate of alumina in combination with the pure carbonate of lime, invariably produced a lime that set under water, within a period more or less long; that they presented a conchoidal fracture; did not evolve much heat in the process of slacking; nor swell to any considerable extent during that operation. All these conditions were found to be present with hydraulic limes; for if the other ingredients that accompany carbonate of lime, are the magnesian carbonate of that base, or the various salts of iron, etc., the product of their calcination will be found to be a poor lime, or one that is moderately hydraulic; but the limestones that contain the silicate of alumina, in combination with the carbonate of lime, in all cases yielded a burnt material that presented these characteristics. VICAT adopted the following classification, founded on the conduct of the limes when mixed with, and immersed in, *fresh* water (for they behave very differently if mixed with, and immersed in, *sea* water); the limes in all cases being firstly properly hydrated, by mixture with only such quantities of water as would be necessary for their retaining the form that was given to them. The limestones that presented the composition of from 8 to 15 parts of clay, or silicate of alumina, to 100 parts of carbonate of lime, he classed as *moderately hydraulic*; that is to say, he found that they would swell considerably in slacking, would give off much heat, and would set under water within fifteen to twenty days. The limestones that contained from 15 to 17 parts of silicate of alumina to 100 parts of carbonate of lime, he classed as those yielding *hydraulic lime*, or such as would set under water in from seven to eight days; and those that contained from 17 to 20 parts of silicate of alumina to 100 parts of the pure carbonate, he classed as the *energetic hydraulic limes*, or such as would set under water in three or four days. The two last varieties he also found would give out less heat, and would swell less in slacking, in proportion as they contained more of the silicate of alumina. Limestones containing a

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greater proportion of silicate of alumina pass into the category of calcareous cements, which require to be ground before they are used, as well as a totally different style of treatment, as already noticed.

The correctness of these opinions was proved by synthetically making the different kinds of lime, by adding the requisite proportion of clay to the pure carbonate; but VICAT recommended that the clay should be added to the lime when slacked, and the whole subjected to recalcination. The difference in the quality of the artificial hydraulic limes thus prepared is, however, very small, that is to say, between those made with slacked lime, or with the pure carbonate mixed at once with the clay; but French engineers seem to be divided in their opinions as to the merits of the whole series of the artificial hydraulic limes, some of them recommending their use, whilst others as decidedly prefer the natural varieties of that article. It seems, however, that much of this difference of opinion may be explained by the fact, already adverted to, of the influence of *sea water* upon the compounds of lime and clay, which are only sufficiently energetic to resist external influences when they have taken place under the influence of great heat; in ordinary cases the artificial hydraulic limes are decidedly successful; and in the case of the Portland cement, there can be no doubt that the mixture of chalk and clay is sufficiently endowed with the qualities of hydraulicity to set under water in a manner to which neither the Roman, nor the natural, cements can attain.

The best *natural* hydraulic limes, used in England, are the varieties known as the Barrow, the Warwickshire, the Keynsham, the Aberthaw, and the Lyme Regis. They are all obtained from the BLUE LIAS FORMATION; the reader is referred to the observations that have been made with respect to them, under that head. If proper precautions be taken in selecting the beds to be worked for supplying the kilns, blue lias lime is eminently hydraulic. There are different beds of the carboniferous series presenting the composition that is required to secure the hydraulicity of lime, which are locally worked to a considerable extent; as are also the subdivisions of the cretaceous formation known locally by the names of the chalk marl, the clunch, etc., which yield a moderately hydraulic lime much prized by builders in the south-eastern parts of the kingdom. The Merstham, Dorking, Guildford, the Cherry Hinton, the Isleham, the Downham Market, and the Swindon, varieties of this lime are the best known; and in London they are used under the name of GREY STONE LIME. It is to be observed with respect to these descriptions of lime, that they are but moderately hydraulic, and that their use is by no means to be recommended where they would have to resist the effects of running, or of constantly renewed water, or where they would be exposed to the action of sea water. The proportions of the silicate of alumina present in the chalk marl appear, however, to be very favourable to their combination with the clay mixed with them in the process of manufacturing the Portland cement; the best factories of that invaluable material being all situated in positions where they can command an unlimited supply of chalk marl. As a lime, grey stone lime is liable to swell too much in the process of hydration, and to give out too much heat in setting, to entitle it to rank very high in the class of hydraulic limes. Besides the works named *s.v.* CEMENT, others will be found *s.v.* LIME. ATMOSPHERIC INFLUENCE; DORKING; GODSTONE; HALKIN; SEA WATER. G. R. B.

HYDRAULIC MORTAR. Mortar composed of a mixture of hydraulic lime and sand. Such mortar is for the most part marked by the small proportion of sand it will carry; the best descriptions of blue lias lime, for instance, will not bear more than $1\frac{1}{2}$ parts of sand to 1 of lime. A good mixture for the execution of sea walling consists of 1 part of chalk lime, or of Halkin lime, with 1 part of pozzolano from Civita Vecchia, and 1½ parts of sand; but the value of this mixture depends upon the

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influence exercised by the pozzolano on the setting of the lime. An excellent description of hydraulic mortar is furnished by the mixture of the natural calcareous cements, or of the Portland cement, with sand; but it must be observed that the presence of the sulphate of lime in any composition that is intended to resist the action of sea water would be fatal, as the sulphate of lime crystallizes at a different rate of rapidity, and it is more easily soluble, than the carbonate of lime. COYLE'S CEMENT; HYDRAULIC LIME.

The object to be aimed at in making hydraulic concrete, is to present to the elements of the rough rubble materials, the necessary quantity of mortar to produce the aggregation of the whole mass. In Portland cement concrete, for instance, the proportions for the mortar may be 1 of cement to 3 of sand, and this mortar may then be mixed with 6 portions of ballast or shingle: in blue lias lime concrete, the proportions may be 1 of lime in powder to 2 or 2½ of sand, and this mortar may be mixed with 3 or 4 parts of ballast; but it must be understood in all cases that the mortar must be made first, and that it should then be thoroughly incorporated with the ballast, or shingle, that enters into the composition of the concrete. ARTIFICIAL STONE; CONCRETE.

G. R. B.

The *Journal* of the Society of Arts, 1856, gives an abstract of a paper, *On the Materials employed in Marine Works*, from the *ANNALES DES MINES*, 5 ser., ix, livr. 2, 8vo., Paris, 1856, presented to the French Academy of Sciences, by — Chatoney, engineer of the Ponts et Chaussées, and — Rivot, mining engineer (given in the *BUILDING NEWS Journal*, 1856, ii, 731). "Particular stress is laid on the following qualities for the formation of good hydraulic mortar: 1. It is essential that the materials should be perfectly pulverised before mixing, so that the combination may be as perfect as possible. 2. Sufficient free lime must be present to allow the carbonic acid in the water to combine with it, and form a protective coating of carbonate. 3. Long soaking of the materials is advisable, in order that the chemical combinations necessary for the ultimate stability of the mortar may take place before it is actually used."

BURNELL, *On the Application of Hydraulic Limes and other Cementitious Materials to Constructive Purposes*, in *Transactions* of the Royal Institute of British Architects, 1857-8, p. 109-18, and given in *BUILDER Journal*, 1858, xvi, 172, 193: which work also gives, xvi, 281-2, an abstract of ROBERTSON, *Investigation into the Theory and Practice of Hydraulic Mortar*, as made at the new works of the London Dock Company, 1856-7, read at the Institution of Civil Engineers: also, 1860, xviii, p. 354, a valuable account of the *Hydraulic Mortar used at the Liverpool Docks*, obtained from Halkin lime; and 1846, iv, 517, *Experiments on Hydraulic Cements at the Liverpool Gas Company's Works*, from Halkin and blue lias limes.

HYDRAULIC, or HYDROSTATIC PRESS. A machine (the origin of which is due to Joseph Bramah in 1785, who obtained a patent 31 March 1796, and hence it was sometimes called 'the Bramah press') in which the practical incompressibility of water is brought into play, with the view of producing great pressure on the surface of the movable head that terminates the engine, and is prevented from moving beyond a certain distance by the resistance of the chains or iron rods that limit its action. In this engine the pressure is put upon the ram by means of a small column of water that is forced into the full body of the cylinder, and the force that is exercised on the area of this column is, by the law of hydrostatics that a pressure exercised on any portion of the surface is communicated to the whole of that surface, transmitted to the piston, which then moves forward with the force impressed upon the column of water pumped in, multiplied by the number of times the unity of measurement is contained in the body of the ram. Thus, if one pound pressure be exercised on the lever of the small pump that injects the water, it may exercise a force at the end of the ram of 70 lbs. on the square inch, if the areas of the inlet of the pump and the area of the ram be in the requisite

proportion. Hydraulic presses are generally provided with a safety valve to indicate the degree of pressure brought upon them.

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An example of its use is thus stated: Required the repulsive force of a 6 in. ram, when a power of 50 lbs. is applied to the end of the lever, which is as 12 to 1, and the diameter of the pump or plunger is seven-eighths of an inch; then, the area of the ram = 28.2744, which divided by the area of the pump = .6013, will give 47: and $50 \times 12 \times 47 = 28,200$ lbs., or nearly 12 tons. Instances of the application of this machine are; the raising the tubes of the Britannia bridge, by one of the largest then constructed, being capable of raising a dead weight of 1144 tons (the tubes of Conway bridge had been previously so raised); the launching of the Leviathan, afterwards the Great Eastern, steam ship, in November 1857; the raising of ships, railway trucks, etc., by the hydraulic lift; the packing and pressing of goods in Manchester warehouses; wool pressing in Australia; cotton pressing in India and Egypt; hay packing for the Crimea in 1854; making clay tubes for drainage purposes; making lead pipes; pressing of hops, stearine, oil, etc.; the proving of beams; and experiments on the compression of materials; as noticed in the paper by BELLHOUSE, *On the Origin and Applications of the Hydraulic Press*, read at the Manchester Congress in 1861 (*BUILDER Journal*, xix, 669). A portable hydraulic press for proving cast iron girders, etc., is given in the *Papers of the Corps of Royal Engineers*, 1 ser., vi, pl. 17-8; the usual form of press will be found figured in most works on *Hydraulics*; the machine invented by Mr. Dunn of Salford, and used at the Paris Exhibition 1855 in testing timber and cables, is shewn in *BUILDER Journal*, xiii, 418. The same *Journal*, xxi, 415, notices a "new 28 inch hydraulic press erected at Woolwich dockyard, for bending and preparing armour plates, which worked up to 1,539 tons by indicator; and afterwards to 1,600 tons without showing any signs of weakness."

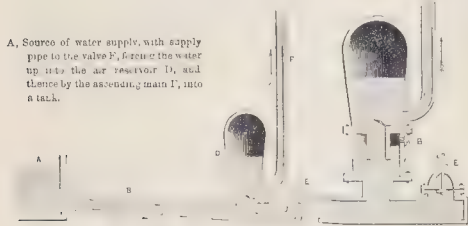
HYDRAULIC RAM, sometimes called WATER RAM. A machine used for raising water. The architect should not be unaware of its capabilities, which might oftener be called into requisition than it is. The principle upon which this engine acts is, that the momentum of a falling body is capable of continuing, long after the movement of the body itself has ceased; and in practice, advantage is taken of this fact to convert the momentum of a body of water into motive power to raise the quantity required. HYDRAULIC JAR. The machine consists in a feeding reservoir, or conducting pipe; of a ram, or the part where the motion is converted; of an air reservoir; and of the ascending main. The water flows through the conducting pipe into the ram, raising a valve which interrupts the flow; and then, as the momentum of the water has ceased, the valve falls back into its seat, and the movement is repeated. In this manner, as the pressure of the water and the weight of the valve alternately predominate, the valve is kept in a constant state of vibration without any external aid whatever. Hitherto, the hydraulic ram has only been used when the quantity of water required to be raised is very small; and it is doubtful whether the machine would be ever able to produce a good action, on account of the violent shocks of the valves, and the jar produced in the ram. The useful effect of the best of these engines has been calculated as being 65 per cent. of the power exercised. They may be usefully employed, however, for the water supply of a country house, or for farm buildings, where there is a stream to serve the column of water flowing in the pipe first described; D'AUBUISSON, *Traité d'Hydraulique*; HACHETTE, *Traité des Machines*, 4to., Paris, 1819.

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The first person who is known to have raised water by a ram designed for the purpose, was Mr. Whitehurst, a watchmaker of Derby in England, in 1772, who forwarded a description of it to the Royal Society, which was published in their *Transactions*, lv. The *belier hydraulique* of Montgolfier

was invented in 1796: he was a French paper maker, and it has been admitted that he was acquainted with Whitehurst's, still he made the ram entirely his own. Boulton took out a patent in England for self-acting rams 13 Dec. 1797 (REPERTORY OF ARTS, 1798, ix), claimed by Montgolfier to be copied from his inventions. When the perpendicular fall from the spring to the valve is but a few feet, and the water is required to be raised a considerable height, then the length of the pipe

A, Source of water supply, with supply pipe to the valve F, forces the water up into the air reservoir D, and thence by the ascending main T, into a tank.



from the spring to the valve must be increased, and to such an extent, that the water in it is not forced back into the spring when the valve closes. A ram has been made to raise one hundred hogsheds of water in twenty-four hours to a perpendicular height of one hundred and thirty-four feet, by a fall of only four and a half feet; EWBANK, *Description and Account of Hydraulic and other Machines for Raising Water*, etc., 14 edit., 8vo., New York, 1857, p. 365-72; 15 edit. 1864.

Prof. Millington (of the Royal Institution) furnished an account of a water ram with his improvements, to the QUARTERLY JOURNAL OF SCIENCE AND THE ARTS, i, 211, which was extracted in ACKERMANN, *Repository of Arts*, 8vo., London, 1841, new series, xi, 142-5, with a plate. In some rams the descending tube has been from 1½ to 6 ins. in diameter, and the ascending tube 1½ in. or less. One had supplied a hundred hogsheds of water in twenty-four hours to the height of 134 perpendicular feet, with a fall of only 4 ft. 6 ins. P. Nouaille of Greatness in Kent, put up one which threw water from a lower into a higher pond, 600 ft. asunder, at the rate of a gallon per minute, with a rise of 24 ft., and a fall of from 4 to 5 ft. The hydraulic ram invented by J. L. Gatchell of America, differs somewhat from the above, in having a flexible diaphragm between the air vessel and the body of the ram, depressed by a spiral spring, by which the ram is made double acting. An illustration of it is given in CRESSY, *Encyc.*, p. 1704, fig. 3163.

This machine is now coming more generally into use, especially in Scotland, where it is made for about £5 or £6 without the piping, which is recommended to be rather stouter than generally specified. They will last for a number of years, the only part liable to be worn is the piston valve, which can be replaced with new valve plates for about twenty shillings. The cost to a farm including everything, varies from £40 to £120 according to the length of piping required. In London, the machine costs from 10 guineas upwards according to its size, and without pipes. In favourable cases it will raise water thirty times higher than the fall working it. With a fall of water, say five feet, the ram will serve a tank eight hundred yards distant, and about sixty feet higher than itself. The village of Kilrea in Ireland is supplied with water from the spring of Tubberdoney, situate 134 ft. lower than the point at which the water is delivered. Through this height, and the distance of 700 yards, twelve gallons of water per minute have been driven; and by an increased opening of the valve from three-sixteenths of an inch, as at present, to six-sixteenths, which is possible, as much more could be supplied. This example of the machine has a great peculiarity, for the driving water and the driven are different, not only in their sources but in their quality, for by a modification of the ram, perhaps not before attempted, they are kept separate while passing through it. The work was carried out for the Mercers'

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Company; DUBLIN BUILDER *Journal*, 1859, i, 90. "The largest ram ever erected was put up at Mello, near Clermont sur Oise, by Montgolfier's son"; it is described, together with tables and notes of the researches by Montgolfier, Eytelwein, and D'Aubuisson, in the CIVIL ENGINEER *Journal*, 1846, ix, 362.

Experiments on the Hydraulic Ram, by Messrs. Hunter and English. (BEARDMORE, *Tables*, etc., 8vo., London, 1852, p. cviii.)

| Fall in Feet
from head. | Quantity of
Water expended
in Gallons. | Water raised in
Gallons. | Height of
Stand Pipe in
Feet, above head. | Time in Minutes. |
|----------------------------|--|-----------------------------|---|------------------|
| 9.32 | 515 | 68 | 40.93 | 14 |
| 9.41 | 493 | 68 | 40.94 | 20 |
| 9.33 | 530 | 68 | 40.92 | 14 |
| 9.31 | 504 | 68 | 40.94 | 21 |
| 9.32 | 514 | 68 | 40.93 | 22 |

The height from the outlet from the ram to the top of the stand pipe was 50.25 ft. The difference in time of filling the cistern is owing to variations in the adjustment of the beat of the valve,—slow motion giving the best duty.

HYDRAULICS. The branch of HYDROLOGY treating especially of the movement of water in pipes, or generally of the laws regulating the movement of that fluid, whether for the purpose of producing motion in machinery, or for discharging a given quantity of water. Thus the discharge from close vessels, from weirs or overflows, from sluices, through channels or pipes; the power of water to drive machinery; the interference with the motion of bodies immersed in water; and the effects of the water upon the materials submitted to it in consequence of the state of motion produced therein; all form parts of the science of hydraulics.

The laws that regulate the flow of water from close or open vessels do not usually come within the limits of the architect's study, and they may be left to the civil or the mechanical engineer, who is usually employed in the construction of lock-gates, weirs, canals, and such like works. But there may be cases to which the attention of the scientific architect may be directed: and therefore the following observations are put forth, simply remarking that the discharge of water is considerably affected by atmospheric pressure; and that, on the supposition that this last takes effect under normal conditions, the formulæ for calculating the dimensions of the respective openings would be as follows. When the orifice is made in a thin plate, or does not exceed in length the smallest dimension of the opening, and is at a maximum from 2 to 2½ ins., the rate of flow is given by the formula of TORRICELLI, $v = \sqrt{2gh}$;

from which $h = \frac{v^2}{2g}$; v representing the velocity; h the height that acts as a head; and g the accelerating force of gravity, which in London is considered to be equal to 32½ ft. in a second. This supposes that the sides offer no resistance to the escape of the water, and that the head be always maintained at the same level; but, if the fluid escapes through an orifice that is more than one and a half times the smallest dimension; or when an AJUTAGE is employed; the formula becomes affected by a coefficient which is taken at 0.82 $v = 0.82\sqrt{2gh}$. The velocity would be again modified if both sides of the opening be under water, and it would be represented by the formula $v = \sqrt{2gh(h-h^1)}$; in which h represents the height of the water over the second recipient, and $(h-h^1)$ the difference of levels in the two vessels. If the discharging vessel should be subject to any pressure, the formula would become $v = \sqrt{2gh(h+h^1)}$; in which h^1 would represent the pressure exercised in the height of a column of the liquid. The theoretical discharge is always represented by the formula $q = sv$, in which q = the quantity discharged per second; s = the sectional area of the orifice; and $v = \sqrt{2gh}$; but the quantity is always diminished from that which would be obtained in the application of this formula, by the diminution of the velocity and the contraction that takes place in the fluid vein. It is necessary, therefore, to affect the quantity by a coefficient

which differs with the pressure upon the sides of the orifice, and its position in the sides of the vessel. PONCELET and LESBROS, in the *Transactions de l'Académie des Sciences* for 1829 and 1842, have written some admirable remarks thereon. It may suffice to mention that in lock-gates, the sills of which are generally upon a level with the chambers, the coefficient of the discharge is taken as being 0.625; with inclined faces to the sluice the coefficient may be as much as 0.74 or 0.80.

The formula for ascertaining the discharge of water over a weir is stated by PONCELET to be $q = k l h \sqrt{2g h}$, in which q = the effective quantity falling over the weir; k = the coefficient of discharge, stated by him to be on the average 0.405; l = the width of the overflow; and h = the height of the water above the sill of the weir; this height must be ascertained where the level of the water is not affected by the contraction of the fluid vein.

The conditions of the flow of water in *open channels* differ from those of its flow in pipes in this respect, that the upper surface is always free, and it is only exposed to the action of the air. It has been found that whatever be the section of a channel, if a uniform velocity be once established in it, the same quantity of water will be discharged at the lower end that enters at the upper; consequently the same quantity of water must pass in the same period of time in any transverse section of the channel. It follows that the velocity of the current, and consequently the inclination of the bed, must increase in proportion to the diminution of the area, if the discharge remain the same; and that the velocity must diminish in the same proportion as the increase of the area. As the rate of flow is, in channels, produced by gravitation, it must naturally increase with the inclination, and with the length of that inclination; but in a channel with a uniform inclination and section the rate of flow would soon become uniform, because the friction of the sides destroys the increase of velocity, which would otherwise be produced by gravitation. It also follows, from the effect of the friction on the wet contour, that the velocity of all the molecules in the transverse section at any point is not equal; for they are retarded in proportion to their proximity to the side producing friction, and of course, under these circumstances, the maximum velocity exists at the surface, and in the axis of the current. From DUBUAT's experiments (*Principes d'Hydraulique*) it appears that the mean velocity represented by v may be expressed by the formula $v = c w$; in which w represents the velocity ascertained to exist at the surface and upon the axis of the current; and c a coefficient varying according to circumstances from 0.76 to 0.891. These indications are found to be far in excess of the actual quantities discharged by great rivers, as the coefficient for the Seine has been ascertained to be 0.62 w ; and the coefficient of the Neva 0.75 w ; but they are sufficiently near for purposes of calculation. It is customary to allow that, for surface velocities varying between 8 ins. and 5 ft. per second, $v = \frac{4}{5} w$; or that $w = 1.25 v$. The velocity of the flow at the bottom is taken at $v = 1.33 u$, in which u represents the velocity sought: the bottom of the channel must be made of a material that will resist the transporting power of the water animated with such velocity.

The relation between the mean velocity of a current and the inclination of the surface, as well as the wet contour, is ascertained by the formula, given by PLAYFAIR (*Elements of Natural Philosophy*) in English dimensions (for DE PRONY's formula), as follows: calling v the mean velocity, r the mean radius, or the quotient of the area of the watercourse by the wet contour; and i the inclination, then—

$$v = -0.1541131 + \sqrt{0.023751 + 32806.6 r i}.$$

There are, of course, some considerations that affect the shape of the channel, as also the conditions that influence the discharge of such channels; for which the treatises upon hydraulics had better be consulted.

"When water flows through long pipes, the velocity of its flow would be increased by the effect of gravitation if the pipes should have a general fall; and as the liquid column is prevented from changing its form by the adherence to the sides of the pipes, and by the resistance of the air, the lower filaments of the liquid transmit a portion of their velocity to the upper ones, and thus establish a general uniform velocity, which increases in proportion to the length of the pipes up to a certain point, beyond which the friction upon the perimeter of the pipes stops the increase. In perfectly horizontal pipes this friction, repeated upon a great length, tends continually to retard the velocity; so that, if the length be considerable in proportion to the initial velocity, the liquid might, under some circumstances, not flow at all"; and on the contrary, the velocity of the flow of water may sometimes be so much increased that the pipes will cease to run full bore, if they commenced to do so. EYRELWEIN observes that in consequence of the existence of this friction, the head of water producing motion in a pipe may be considered to be divided into two parts, one of which serves to generate the velocity, and the other to overcome the friction. This latter portion must, therefore, be directly as the length of the pipe, and the circumference of the section; and inversely as the contents of the section: the other causes of loss of velocity that occur in pipes are those occasioned by bends, the changes in the direction of flow, and the gurgitation that is produced at every interruption in the flow. It is to be observed that the opinions of the first observers upon this branch of hydraulic science, to the effect of the surface of the pipes having no influence upon the rate of delivery, have been lately very much questioned by engineers; DARCY has shewn, by his experiments upon the discharge of water from pipes, that the nature and the state of the surface have a considerable influence on that quantity, and that the influence of the diameter upon it was greater than would be indicated by the formula of DE PRONY. In capillary tubes the effect of the contour upon the flow of the liquid is, of course, greater than in tubes of larger diameter; but these become affected by such peculiar hydraulic laws that they may be for the present left out of account.

The inquiry into the strict conformity of the results of actual experience with those indicated by the formulae are, however, too abstruse for the present object of this article. It may, therefore, suffice to say that the quantity of water flowing through a pipe of uniform diameter, receiving its water from a reservoir at a higher level, and discharging it into another reservoir at a lower one, without any change in the direction of the pipes, may be ascertained with a sufficient degree of accuracy by the

formula $q = c \sqrt{\frac{h + \xi - h^1}{\lambda}} d^2$, in which q = the quantity

discharged; ξ = the difference of level between the extreme orifices; λ = the length of the pipe; h = the head upon the upper, and h^1 that upon the lower orifices; d = the diameter of the pipe; and c = a coefficient varying with the rate of flow, from 15.06 for a velocity of 2 ins. in the second, to 20.78 for that of 78 ins. in that space of time, and for any velocity beyond this $c = 21.043$. The above formula cannot of course be applied if the velocity be unknown; and, if this should not be ascertainable by actual observation, it may be calculated as follows. Let $k = \frac{h + \xi - h^1}{\lambda}$ in which the previous notation is retained, then, according to PLAYFAIR's translation of DE PRONY's formula—

$$v = -0.1541131 + \sqrt{0.023751 + 32806.6 \times \frac{d k}{r}}.$$

All the indications thus given are, however, less than those that are found to prevail in practice, and they require to be modified by a series of precautions that are to be found described in the best works upon the subject. It is, however, always preferable to obtain lesser results than those which experience would seem to indicate, for the pipes are always

exposed to have their diameter choked up by the depositions that take place in them.

The friction, and consequent loss of head, upon water flowing in pipes is considerably increased by any changes in the direction of the latter, whether it be in the horizontal or vertical direction; and this increase is found to be in a certain definite proportion dependent upon the ratio of the diameter of the tube to the radius of curvature of its axis. NAVIER gives, for the purpose of ascertaining the loss of head, in metrical dimensions, the formula $h' = \frac{v^2}{2g} (0.0039 \frac{1}{r} + 0.0186) \frac{a}{r}$, in

which r = the radius of curvature, and a = the development of the arc; according to this observer it appears that h is proportional to the square of the mean velocity, and to the length of the arc, and is independent of the diameter of the pipes; and that h decreases as r increases. The other causes of the diminution of the discharge of pipes are affected by so many circumstances that there can be little good in attempting to lay down any general rules for ascertaining them, or, for the architect's purposes, in going into them. PIPE; FOUNTAIN.

LAWS and BURNELL, *Elements of Civil Engineering*, 12mo., London, 1852, contains a full account of the bibliography of the subject of hydraulics; the following works may be here named. NEVILLE, *Hydraulic Tables, Coefficients, and Formulae, for finding the Discharge of Waters from Orifices, Notches, Weirs, Pipes, and Rivers*, 8vo., London, 1860, new edit.; DOWNING, *Elements of Practical Hydraulics*, 2nd edit., 8vo., Lond., 1861; PEACOCKE, *Hydraulics, Practical and Experimental Researches*, 4to., Lond., 1846; DWYER, *Principles and Practice of Hydraulic Engineering*, 2nd edit., 8vo., Lond., 1852; AMIESON, *Mechanics of Fluid*, 8vo., Lond., 1837; CHAMBERS, *Educational Course, Hydraulics*, etc., 8vo., Edinburgh, 1845.

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HYDREUMA, or FONS TRAJANUS, in Egypt. The town is of considerable size; the houses are well built, considering the roughness of the materials, and outside the walls are a temple and other buildings. In the quarries are some large columns, and round blocks probably intended for their bases and capitals. The granite quarries, which are very extensive, are situate in that part of the Claudian mountain, now called Gebel el Fateerh, on the Nile; the stone has a white ground with black spots, some columns of which are still seen at Rome. 28.

HYDRIAPHORA. The name given by WILKINS, *Prousiones*, 4to., London, 1837, p. 63, to the statues of females which supply the place of columns in the prostates at the Erechtheum at Athens. CARYATIDE.

HYDROBORONATED PLASTER. A patent plaster composed of common plaster of Paris or any plaster having sulphate of lime for its base, and indurated with a solution of boron. This solution can be made of varied strength, so the cement may be made to set in any period, say in a few hours or moments, according to the work to be bestowed upon it. The effect of the hydroboron is to render the plaster very hard and to fit it for the imitation of marbles and stones. Its actual strength is considerable. The process ensures the evaporation of the liquid, hence the surface is fit for paint almost immediately. It is said to possess every advantage claimed on behalf of other cements, besides its setting being retarded according to desire, and its being cheaper. It has been principally used in the imitation of marbles and stones. *Builder Journal*, 1858, xvi, 560. The plaster usually called Parian cement is the same as this, with admixture of other ingredients.

HYDRODYNAMICS. The science of the laws of the motion of fluids, which consists of two branches—1. The science of HYDRAULICS refers principally to the machinery for conducting fluids; and 2. That of HYDROSTATICS, to the pressure, equilibrium, and cohesion of fluids.

HYDROFUGE, see GLASS, p. 48.

HYDROGEN. A gas that is of very common occurrence in a compound state, and most readily obtained from water, of

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which it forms about one-ninth part. It occurs in smaller quantities in combination with phosphorus, sulphur, iodine, bromine, carbon, lime, and nitrogen; and finally in almost all organic substances. According to the latest authorities its specific gravity is between 0.691 and 0.695, or about fourteen and a half times lighter than air. Though very inflammable, it does not support the combustion of other bodies. It is inodorous in the pure state; but, as commonly obtained, it has a disagreeable smell. Small animals introduced into this gas die immediately; and with man the pure gas excites, after two or three inspirations, disagreeable sensations and loss of muscular power. The architect has a direct interest in studying the action of this gas, on account of the peculiar nature of the compounds into which it enters, such as limestone, plaster, producing the hydrated limes, plaster, etc., the hydrous oxides of iron, or other metals. The compounds so formed are all of great importance as regards their stability, or as to their decay; and they will therefore be considered under LIME, OXIDATION, PLASTER, RUST, VERDIGRIS, etc. Hydrogen forms several compounds with oxygen, such as the peroxide and the suboxide of hydrogen; it also forms ten inorganic hydrogen acids, or hydracids, nine of which are non-metallic hydrogen acids, the tenth is metallic.

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HYDROLOGY. The science that treats of the properties and the conditions of water. The most complete treatise on the subject is by BEARDMORE, *A Manual of Hydrology*, 8vo., London, 1862, 20 pl., with 400 pp., and therefore a short abstract of the contents of that work will best set forth the subjects comprised under the term. The work gives in division 1. Hydraulic and other tables, with descriptive matter, the whole placed in a concise form. Division 2. On rivers and flow; on percolation of water; on wells and springs. On the flow in sewers, and water supply, with description of the floods of many considerable rivers, with other characteristics appertaining to their hydraulic conditions. Division 3. On tides, tidal rivers, estuaries; containing the strictest details of the conditions assumed by the tides under the varied states of the bore, and of those places where the tidal wave vanishes, also showing the effect of improvements in many of the tidal rivers of this country. Division 4. On rainfall and evaporation; containing the best experiments on evaporation in various climates; tables of rainfall under every variety of elevation, period, and locality; these include all parts of the British Isles, France, Germany, Italy, Russia, North America, Australia, and India.

HYDROMETER. An instrument for measuring the specific gravity of various spirits and other fluids by floating in them. The AREOMETER is similar to it.

HYDROSTATIC PRESS, see HYDRAULIC PRESS.

HYDROSTATICS. The science that treats of the forces exercised by water in repose, and the resistances offered to them by the containing vessels. *Hydrostatical*, differs from *Hydraulic*, science, inasmuch as the latter is exclusively concerned with the laws of running water, whilst the former deals with that fluid in repose.

The principle of hydrostatics is the weight of the water, and in the conditions of the mobility of the particles of which it is composed; in the incompressibility of that fluid, within ordinary conditions at least; and in the fact that any pressure exercised upon any portion of the surface of the fluid is transmitted throughout every particle. It is upon these principles that may be explained the various phenomena of specific gravity, of the hydraulic, or more correctly speaking the hydrostatic, press; of the pressure upon the sides of embankments or reservoirs; and of the movement of bodies through the water. When water is perfectly pure and at its maximum density, its weight may be taken at 62 lbs. 5 oz. avoirdupois per cubic foot, and its specific gravity may be considered to be represented by that quantity. There are, however, three causes that diminish or add to that weight; viz. the temperature, the salts that may be present, and the atmospheric pressure. The im-

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portance of the first of these causes of diminished pressure may be understood by the fact that water at its greatest density, which corresponds with the temperature of $39^{\circ}20'$, being taken at 1000, its weight at $21^{\circ}2'$ will only be 0.9567; and at 32° , the freezing point, it will be 0.9300. The effects of the salts may be neglected, for soft waters at least, as river waters which are most charged with salts in dissolution, rarely have a specific gravity that exceeds 1.00015; that of sea water is much greater, it is 1.028, and the weight of a cubic foot is about 64 lbs. 2½ ozs. The loss of weight arising from the displacement of the air by the water, may vary between $\frac{1}{10000}$ to $\frac{1}{100000}$ of the latter; but the rate of compression of the water is so very small, that it may safely be left out of account. Under the pressure of one atmosphere, the diminution of the water in bulk is not above 0.000046 of the original volume.

Every layer of an homogeneous fluid supports an equal pressure on every point of its surface, so that the sum of pressures is equal to the weight of a liquid cylinder whose base is the surface of the layer, and whose height is the distance of this layer from the surface of the fluid added to the height corresponding to the pressure that may be brought upon it. The pressure exercised upon any portion of a containing surface, whether horizontal, vertical, or inclined, is perpendicular to that surface, and this pressure is equal to the weight of a column of water having for its base the portion of the surface under consideration, and for its height the distance to the surface of the liquid, provided this acts freely. On this principle, the pressures being equal upon all points of the lower horizontal surface of the vase containing the fluid, the total pressure it supports is equal to that of the liquid column, whose base might be that surface, and whose height might be the distance between it and the upper surface of the fluid; so that this pressure would remain the same, whatever be the form of the vase, provided that the area of the bottom and the height of the liquid did not vary. It is upon these laws that the degree of resistance that ought to be given to the sides and bottom of vessels containing liquids ought to be calculated; and this resistance, it must be observed, ought always to be in excess of what is theoretically required, as the force that is exercised is one greatly calculated to develop the fatigue of the materials exposed to it. The tangential traction exercised by the fluid upon the sides of the vase containing it, may be represented by the expression $r p$; in which r = the radius, and p = the pressure supported by the sides of the ring. It is often necessary to apply to the exterior of a vase a resistance that should be greater than the force tending to overthrow it, and to concentrate this action in the point known as the centre of pressure. This centre of pressure is, from the above traced laws, below the centre of gravity of the fluid; and it is found that in the case of a rectangular surface whose upper side coincides with the surface of the water, it is to be found at two-thirds of the height from the top. The centre of pressure of a triangle whose base is horizontal and upon the water line, is in the middle of the line joining the summit with the middle of the horizontal base. The centre of pressure of a triangle whose summit is at the water line, and whose base is horizontal and at the lower level, is on the line joining the summit to the middle of the base, and at three-fourths of the height, or the distance of the summit. But it is to be borne in mind that, whatever be the pressure supported by the sides of the vessel, the resistance of the bottom must always be ascertained by the vertical weight of the whole mass, calculated upon the greatest depth of the water; and in close vases, if any pressure be exercised upon the surface it will be transmitted through the whole body of the liquid.

Water, owing to the equal distribution of the pressure upon its surface, will stand at the same level in vases that communicate with one another by passages that are of considerable dimensions; but when these passages are very small, the capillary action of them may interfere with the action of this law.

The energy of capillarity, however, depends very much upon the form, disposition, and distance apart of the sides of the tubes which excite it; in minute cylindrical tubes it is greater than in such as are prismatic, and in both it is greater than between parallel plates. The reader who would desire to be more intimately acquainted with the laws of CAPILLARITY, is referred to the works noticed s. v., and to BIOT, *Traité de Physique*, 4 vols., 8vo., Paris, 1816; the work by PÉCLET on the same subject; and to D'AUBUISSON, *Traité d'Hydraulique*, 8vo., Paris, 1840.

The laws which enable a body to remain in equilibrium in the midst of a liquid are, 1, that its weight be equal to that of the fluid displaced; 2, that the centre of gravity of the body and of the displaced fluid be upon the same line; and 3, that the centre of gravity be as low as possible. When the body floats upon a liquid, the conditions of equilibrium are virtually the same as when it is submerged; and it follows that in order that a body may float upon the surface of a liquid, its weight must be less than that of an equal volume of the latter; the equilibrium will only be stable, however, when the centre of gravity of the body is lower than that of the water displaced. The property by which bodies displace a quantity of water equal to their volume, when their specific gravity exceeds that of the water itself, is usefully applied in the arts to ascertain their precise weights, if their specific gravity be known. All that is required in such cases is, that the weight of the volume of water displaced should be multiplied by the specific gravity of the material, and the result will be the weight of the body itself, let its form be ever so complicated. Specific gravity means the ratio of certain bulks of substances considered with reference to equal bulks of some other substances, in fact, those with which they are compared; and water being the body with which comparisons are more easily made, it has been adopted as the standard of comparison for all substances that are of an analogous weight; atmospheric air in a perfectly dry state is, however, the standard that is adopted in any calculations upon the specific gravity of gases, or other similar bodies. GRAVITY (SPECIFIC).

G. R. B.

HYGROMETER. An instrument for ascertaining the quantity of moisture held suspended in the atmosphere. That known as professor Daniel's is considered the best instrument.

HYLAIRE or **HILAIRE** (GAUTIER DE SAINT) is noticed in a document dated August 1251 as "magister Galterus de Sancto Hylario, cementarius, magister operis" at Rouen cathedral, of which it is said that he was the third architect; and that he was living in the parish of S. Michael in Rouen, in a house belonging to the cathedral, at a rent of 8 livres tournois; DEVILLE, *Revue des Arch. de la Cath.*, 8vo., Rouen, 1848, p. 15-7.

HYLING. A term used for an AILE in the contract dated 24 Henry VIII (1533) for rebuilding within four years, the "north and south hylings" of Burnley church (Lancashire); WHITAKER, *Whalley*, 4to., Blackburn, 1801, p. 298. HEALING, and HELE, are terms used for roofing.

HYLMER (JOHN), freemason, with W. Vertue, agreed by indenture dated 5 June, to build with freestone the vaulting of the choir of S. George's chapel at Windsor, consisting of seven severys, for £700, and to complete it by Christmas 1508. BRITTON, *Arch. Antiq.*, iii, 35; TIGHE and DAVIS, *Windsor*, 8vo., 1833, p. 422; POYNTER, *Windsor Castle*, fol., 1811; and noticed in *Transactions* of Royal Institute of British Architects, 4to., 1842, p. 60. Wastell and Semerk completed the vaulting.

HYMENÆA **COURBARIL**, West India locust, or Locust wood. An abundant and valuable timber tree of Trinidad, of a diameter from 2 to 6 ft.

71.

It is also a native of North America; the wood is hard, very tough, and much used in making trenails for ship carpenters: its colour is a light yellow. The quantity imported in the form of trenails is very considerable; ARCHER, *Pop. Econ. Botany*, 8vo., London, 1853: it might be used in roof carpentry.

HYMETTIAN MARBLE. A white marble procured from quarries at Mount Hymettus, near Athens, in Attica. HORACE, *Od.* ii, 18, speaks of it as being used at Rome for architraves resting upon columns of Numidian marble: and PLINY, *H. N.*, xxxvi, 3, mentions that "L. Cassius, Orator primus peregrini marmoris columnas habuit Hymettias."

CORSI, *Pietre Antiche*, 8vo., Rome, 1833, notices this marble as called 'marmor cipolla', on account of the fetid and onion-like odour emitted when being worked. In colour it is a dingy white with a slight tinge of green marked by long parallel dark grey veins of unequal breadth; the texture is compact; and is composed of large particles. At Rome, forty-six columns in the old basilica of S. Paolo fuori le mura, forty-two columns in S. Maria Maggiore, and twenty columns in S. Pietro in Vinculi, are all of this marble.

HYNDELEY or **HENDELEY** (WILLIAM) was appointed master mason of York cathedral on the death of R. Spillesby in 1472. He is considered to have come from Norwich, as in 1473, 100s. was paid for him as the cost of a suit brought against him; and to have designed the rood screen at York between 1475 and 1505, as his device, 'a hind lodged', may be observed on it. In 1478-9 he had twelve masons under him; 1485 eleven masons; 1498-9 thirteen masons; and cir. 1504 twelve masons. The testamentary registers give the Will of "W. Hyndeley de Ebor, latamus", dated 24 June 1505; he was to be buried under the new campanile near the tomb of his wife; and he left, after various legacies, the residue to his wife Margaret and "Henrico Plomer filio meo"; SURTEES SOCIETY, *Fabric Rolls of York*, 8vo., Durham, 1859, pp. 77, 79, 80, 83, 88, 90, 92, 208. Probably Michael (p. 140) and Edward (p. 324) Hindles of 1634 and 1679 were descendants.

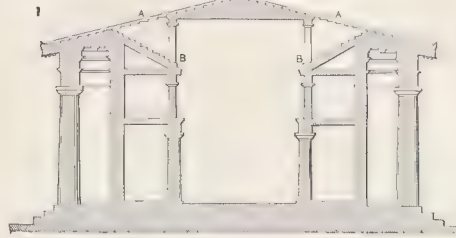
HYNDELEY (THOMAS), master mason, bound himself with others in 1416 to complete the works by Mich. 1418, of the fourth part of the cloisters at Durham for £200; SURTEES SOCIETY, *Hist. Dunelm. Scrip. Tres.*, 8vo., Durham, 1839. In the middle of the cloister quadrangle stood an octangular edifice enclosing a lavatory; this was erected 1432-3, when Hyndeley was paid 103s. 10d. for "winning the marble, and a further sum of 42s. 1d. for drawing it from the quarry and for scappling and 'waynyng' it." A 'loge' was erected in the cemetery garth, and he was again employed in putting a finishing hand to the marble; this operation and the shed cost 11s. 3d. (RAINE), *A Brief Account of Durham Cath.*, 8vo., Durham, 1833, p. 89-90.

HYPÆTHRAL. This word is derived from the Greek words *ὑπο* and *αἶθρᾱ*, clearly signifying anything without cover, or open to the sky. In EURIPIDES, *Androm.*, 227, the drops of dew from heaven are called *παῦδ' ὑπαιθρίας ὀρόρου*. It is used by HERODOTUS, THUCYDIDES, and POLYBIUS, to signify out-door camps (CASAUBON, on the last author, i, 12, 14, xl, 6). The phrase 'sub dio' is interpreted by FESTUS, s. v., "that which is under heaven, beyond the roof" (quod sub cælo extra tectum).

Hypæthral is the term given to the seventh form of temple described by VITRUVIUS, iii, 1. After naming the characteristics of the first five classes, he writes, "now the dipteral [the sixth] is octastyle both in pronaos and posticum, but round the temple it has a double order of columns, as in the Doric temple of Quirinus, and the Ionic of the Ephesian Diana, built by Ctesiphon. The hypæthral [the seventh class] truly is decastyle in pronaos and in posticum. It has all other parts as the dipteros, but in the interior part it has columns double in height, removed from the wall as a circuit of peristyles like a porticus. But the middle is under the sky without a roof (medium autem sub divo est sine tecto), the approach of the doors is on both parts in the pronaos and posticum. Now there is no example of this at Rome, but there is an octastyle [example] at Athens, in the temple of Jupiter Olympius."

It is believed that, since the first reprint of the works of VITRUVIUS, every editor has, without exception, considered the

plan of the hypæthral temples to have been like that of dipteral temples, except that the naos formed a porticus or sort of cloister, or court surrounded by a double colonnade, open to the sky, without any roof, the upper range of columns forming an inner gallery from whence spectators could look down on the ceremonies below; such a court being to the temple what the atrium displuviatum was to the private house. Professor ROSS has, however, lately contended that these temples were entirely roofed, and had no light except through the door. This has been controverted by professor BÖTTICHER, who insisted upon some opening, if only to let out the smoke of the sacrifices: and since then, FERGUSON has contended that the hypæthral temples were roofed, but received light and air by a sort of clearstory as in fig. 1, which is a section of the Par-



thenon, the inner ranges of columns having similar proportions to those at Pæstum, and what may be gathered from Ægina and Agrigentum.

The main arguments for these views seem, when condensed, to be these:—1. That it is impossible to conceive a civilized people like the Greeks to have built a temple without a roof; that the interior must have had light somewhere; and that the light could only have been obtained by openings in the roof like those in the above figure. 2. That it would have been impossible to preserve the chryselephantine statues in an open space exposed to the weather, such as the hypæthron or unroofed naos, as usually described, would have been. 3. That the Egyptian temples were all lighted by an upper range of windows like a clearstory, and that probably the Greek arrangement was borrowed from them. 4. That the description of VITRUVIUS contradicts itself; he having stated that hypæthral temples are decastyle, and then immediately quoted an example which is octastyle. 5. That hypæthron does not mean part of a building, but an open square or piazza, *sub divo*, and surrounded by porticoes. 6. That the explanation given by professor BÖTTICHER of a passage in the *Digests*, L. 16, 242, § 4, where he supposes a temple (ædes) to be occasionally covered with a 'stratura' of movable boards, is incorrect, and that such stratura applies to a flooring, or some other construction. 7. Exceptions are also taken as to the temples at Bassæ and Ægina, which depend partly on considerations of their size, and partly on their peculiarities, and which will be noticed hereafter. 8. That the break in the roof caused by the hypæthron as usually drawn, would have been such a deformity that no Grecian eye could have designed or tolerated it. These appear to be the principal heads under which the arguments in favour of the new views range.

The replies to these points seem to be:—1. (a) That the greater part of both the public and private edifices of the Greeks and Romans were only partially roofed; that the amphitheatres and theatres had only a very small portion covered; and that in every private house of any consideration there was a large unroofed space in the middle called atrium. (b) That there is no attempt to assert that the hypæthral temples were absolutely without a roof; that all VITRUVIUS says is, "the middle [of the temple] was under the sky and without a roof"; and that the theory that the whole was covered, leaving only holes for light, is a direct contradiction to the plain statement of the

author. (c) That though it is not natural for a German, living in a northern climate, to conceive any dwelling not entirely roofed over, yet such an arrangement was not only common in early times, but is so now in Italy, Greece, and all warm climates, and that to this day it is found the most comfortable that can be devised, as it affords complete ventilation; the cold weather being of so little moment that the greater part of the houses are built without any fireplaces except in the kitchens. (d) That if more light were needed, it could have been obtained in a far better way by leaving spaces as windows in the walls of the cella opening under the outer peristyle; if privacy were necessary, they might have been kept up close to the soffit; and if more light still was wanted on account of such height, the metopes opposite might have been left open. This was an ancient practice, as is learnt from EURIPIDES, *Iphig. in Taur.*, 113, where Pylades, wishing to know whether the image was still in the temple, proposes to get up and look in at the void space by the triglyphs ("εἶσω τριγλύφων, ὅποι κενόν"); LIDDELL and SCOTT, s. v. ὀπή, μετόπη. In like manner the Phrygian, EURIPIDES, *Orestes*, 1355, who has been fastened into the house, says he has escaped by "the cedar beams and Doric triglyphs", probably over the timber architrave and through the metopes. This would have been a better method than openings, fig. 1, A A, close to the sloping parts of the roof, which must have let in the driving rain, while those just alluded to would have been upright and protected by the peristyle. (e) That it was part of the religious system of the ancients for the statues of certain gods to be placed in the open air, which can hardly mean under a roof. VITRUVIUS, i, 2, states that those to Jupiter, to the Thunderer (Fulguri), to Cælum (Uranus the father of Saturn), to the Sun, and to the Moon, should be hypæthral and "sub divo". The temple to Terminus, an attribute of Jupiter, built more than two hundred years before the Parthenon, was open at the top in the upper part of the roof ("suprema pars tecti patet", SERVILIUS, *Æneid*, lib. ix, 448), so that the stars might be seen; OVID, *Fasti*, ii, 665; LIVY, i, 55; and even in the present day at the Pantheon there is an opening in the middle (the "medium" of VITRUVIUS), in the upper part (the "suprema pars tecti" of SERVILIUS) between 30 and 40 feet in diameter, through which the rain falls and is carried away by an old drain in the centre, towards which the pavement is laid sloping every way: the Pantheon being dedicated to all the gods, it would have been "nefastum" to have covered it entirely with a roof.

2. As to the protection of the statues in the naos, it has been answered:—(a) That though marble statues will not bear the action of the open air in England and Germany, they have done so in Greece, Italy, and even parts of France, for ages; the sculptures of the Parthenon are wholly uninjured by the weather, the marble statues therefore needed no protection. (b) The chryselephantine statues which were made of wood and covered with thin plates of ivory, the garments being gilt and painted (PAUSANIAS, vii, 592; STRABO, viii, 853), would of course require protection against shrinkage, and expansion from heat and from rain or damp. This protection seems partly to have been afforded at Athens by pouring water round the statue, as the ground was there very dry; and at the Altis in Olympia, by the like use of oil, as the ground there was damp, as mentioned by PAUSANIAS, v, 403; and partly by the use of veils or awnings. PAUSANIAS, v, 405, calls this protection *παρὰπέρασμα*, and says there was one at the temple of Jupiter at Olympia, of wool woven by the Assyrians and dyed purple. Fortunately the exact meaning of the word *παρὰπέρασμα* is obtained from XIPHILINUS, *Epitome of Dion Cassius*, 63, cap. 6, where it is applied to the velarium stretched over the theatres to keep off the sun. No curtains or velarium could long keep out the heavy rains which fall in Greece and Italy; they are almost tropical. There must therefore have been some other method. Three ideas as to how this was done have been suggested. It must be remembered, that

the openings, fig. 1, A A, would have shot the driving rain direct on the statue, down the slopes A B, instead of being a protection to the cella. (c) CANINA, *Archit. Greca*, pl. 50, supposes that at Elis a portion of the roof of the internal part of the hypæthron was returned across the building from side to side, projecting sufficiently to cover the statue; as fig. 2, A B, which



is the section of the temple of Jupiter at Elis; and fig. 3, which is that of the same deity at Ægina: and this idea he takes from the passage in STRABO, viii, 354, who, describing the chryselephantine statue of Jupiter at Olympia, which was in a sitting posture, says it was colossal, and almost touched the roof with its head. As the statue of Minerva in the Parthenon is stated by PLINY, xxxvi, 4, to be 26 cubits high, or with the pedestal probably over 50 ft. English, and consequently must have been too high to have been protected by such an expedient, CANINA supposes there was a species of baldachino or canopy (fig. 4)



over it, to which the *παρὰπέρασμα* were attached, and which served at once as a protection from the rain and sun. This baldachino, professor DONALDSON, *Archit. Numis.*, 8vo., London, 1859, p. 87, etc., from several coins, particularly one of the Samian Juno, supposes to have been of arched or vaulted form (in later times at any rate), as the coins seem to evidence. (d) Professor BÖTTICHER believes that the opening was covered with moveable boards in very bad weather, when any veil or *parapetasma* would be insufficient to keep out the wet. He cites a passage from the *Digests*, L. 16, 242, § 4, "Labeo says that the covering of any place made of boards (*stratura ex tabulis factis*) which may be taken away in summer and replaced in winter, belongs to the building (*adium esse*). Of this more will be said presently.

3. In answer to the assertion that the Egyptian temples were similarly lighted, and so probably gave rise to the supposed Grecian arrangement, it is sufficient to refer to the sections given s. v. *HYPOSTYLE*, where it will be seen that it is not the temple itself, but the columnar halls which are so lighted; of these the openings are marked A. They are all vertical, receiving the light laterally, and have sloping roofs near them, as A B, fig. 1.

4. A closer examination of the passage will show that VITRUVIUS does not contradict himself. It is simply one of those

cases where *exceptio probat regulam*. His meaning is evidently that in general hypæthral temples are decastyle, but not always, for he says plainly there is one at Athens which is not so, it being octastyle. Besides this, some authorities have thought that the Parthenon has one other characteristic of the hypæthral temple, viz. a door into the pronaos and one into the posticum from the cella. It will be well to add that in the opinion of Mr. Donaldson, who "searched carefully for any difference in the surface of the slabs, there is nothing to indicate the existence of two doorways, or of one or any doorway between the cella and the opisthodomos."

5. (a) It is perfectly true that there are places called hypæthral which are not parts of temples. VITRUVIUS, v, 9, speaks of porticoes "sub divo" ornamented with gardens, or viridaria, sometimes attached to theatres, and these he calls hypæthral. To be consistent the German theorists should contend that these were roofed and lighted by side openings; but this would be manifestly impossible, or they could not be planted. VITRUVIUS twice says they are "sub divo", and once calls them "open" (*apertis hypæthrisque*). How then can it be supposed that when he says the middle of the temple is "sub divo" (which surely must be perpendicularly under the sky) and without a roof, that after all they are not under the canopy of heaven, and that a roof goes over the whole of this middle.

(b) There is great probability, however, that STRABO did understand by the phrase "hypæthron" part of the inside of a temple, for he says, xiv, 637, while describing that of Juno at Samos, "without (*χωρίς*) the temple were many pictures", probably under the peristyle; "in the chapels (*ναῖσκι*) were also many pictures", probably under the inner peristyle; and the hypæthron (*ὑπαίθρου*) in like manner is full of noble statues." The pictures being in a species of distemper required to be under cover, while, as has before been observed, the statues did not. The writer in all probability described as he went on, first the outer, then the inner colonnades, and then the open centre. He gives much the same account (xi, 596) of the temple of Jupiter Soter in the Piræus, except that he calls the inner peristyle the smaller colonnades (*στοῖδια*) instead of *ναῖσκι*.

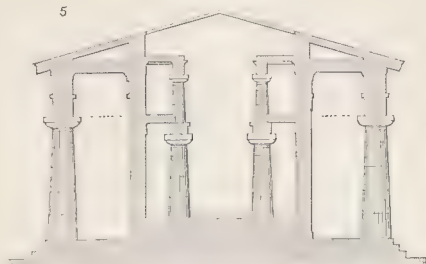
6. (a) This "stratura" generally means a covering, as the covering of a bed, the saddle cloth of a horse (PLINY, *Nat. Hist.*, vii, 56; LUCRET., iv, 84; SENECA, *Epist.*, 81); and in hot countries the floors are generally covered with tiles, cement, or marble, for the sake of coolness, so it is most unlikely boards should be laid in a temple where there were continually burnt sacrifices going on. (b) Such a covering of boards is used to the present day over the courts of the houses in Damascus, and even in China (as shown in *Illustrations*, s. v. CHINESE ARCHITECTURE).

7. It is said that the temples at Ægina and Bassæ are so small that it would be inconsistent not to suppose they were covered. But this would be contrary to the religious principles of the ancients, if dedicated to certain gods, as has already been shown above (1 e). It would have been "nefastum" not to have left a vertical open space in the roofs of such temples, whether large or small.

8. It is answered that the break or notch in the roof alluded to would be very little noticed, as the pitch is so flat; as the temples were generally on elevated sites, to which the spectator would look up; and as much of the roof would be hidden by the antefixæ at the eaves: besides that nothing, which really was required in carrying out the religious notions, and which therefore arose out of the necessity of the matter, would convey the idea of ugliness.

These seem the principal points in answer to the late theories. But those who maintain the old ideas assert still further. A. That the historian JUSTIN, xxiv, 8, describing the attack of the Gauls on the temple at Delphi, says the priests cried out they saw the god leaping down into the temple through the open top of the ridge, "per culminis aperta

fastigia". A similar incident is related by LUCIAN, *Pseudomantis*, cap. 39, where the Moon is represented as visiting Endymion. He is sleeping within the house, and the goddess descends to him from the roof, *κατῆι δὲ ἐπ' αὐτὸν ἐκ τῆς οροφῆς*. Such an ascent or descent would appear easy and natural in temples if constructed like the Parthenon, fig. 4, or that at Pæstum, fig. 5; but it would be most awkward and undignified for a figure to slide down the slopes A B, fig. 1, or to go side ways out of them: and besides that, such slopes could not well be called either *ορόφη* or *culmen*. FALKNER, *Dædalus*, 8vo., London, 1860, introduction; and *On the Hypæthron*



etc., 8vo., London, 1816, p. 29, etc. B. That a similar deduction may be made from a passage in PLUTARCH, *Pericles*, xiii, where he describes the temple at Eleusis, and says Coræbus began the temple, he died, and Metagenes made the cella and the upper columns, and "that Xenocles of Cholargus placed the opaion on the highest point of the temple" (*τὸ δὲ ὀπαῖον ἐπὶ τοῦ ἀνακτορῶν Ξενοκλῆς ὁ Χολαργεὺς ἐκορύφωσε*). *Κορυφή* is the highest point of anything, the vertex of a triangle, and of the head of a man. Now it is argued that whatever Xenocles made, it was at the vertex or upper part, the 'culmen' of JUSTIN, the 'suprema pars' of SERVILIUS, and not half way down the slope; that the *opaion*, whatever this may mean, was at such highest point; that this word is derived from *ὄπη*, which, as has before been explained (1, d), signifies an opening; that the termination *αιον* would probably infer a large opening; and that the word is singular, and at any rate must signify one opening only, instead of several on both sides of the slope of the roof. C. Reference has also been made to the second book of MACCABEES, i, 16, where the murder of Antiochus in the temple of Nanea is narrated: "And opening a privy door in the roof they threw stones (probably the roof tiles, which were often cut out of solid marble) like thunderbolts," etc.; and it is contended this could scarcely be done as in fig. 1, but readily as in the other figures.

It is also contended that the theory of the Germans is suggested partly as a startling novelty, and partly in accordance with northern ideas of comfort; that they misunderstand VITRUVIUS, who does not pretend, like STRABO or PAUSANIAS, to give minute descriptions of individual buildings, but only of the general rules applicable to their classification; and that allowance must be made for exceptions. Thus a writer of this country might say truly, the English do not build in a foreign manner with open courts or atria; but such a dictum would not be taken to prove that the Royal Exchange in London is not open; in fact that building is a very good specimen of a hypæthral building, and one which now almost stands alone. Two arguments have also been used, which seem to favour either views. One is deduced from finding the angle tile at Bassæ, which some say was intended for the finish at the mitre of an opening in the roof; but such tiles might as well have been used to two openings as to one: the other is drawn from the circumstances that there were marks of tiles running up the backs of many of the pediments; but this proves nothing, as it is well known the anticum, and posticum, at

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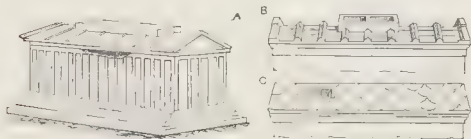
least, were entirely roofed; and, as it has always been contended, the *middle only* of the temple, the part surrounded by the inner peristyles, is "sub divo sine tecto."

FERGUSON, *Principles of Beauty in Art*, 8vo., London, 1849; Paper read by him 4 Nov. 1861, at the Royal Institute of British Architects, with discussion thereon; and continuation in the *Builder Journal*, xix, 863, 893.

A. A.

FALKENER, *Museum of Classical Antiquities*, 8vo., London, 1851, i, 173, thinks it may almost be regarded as the fixed principle in hypæthral temples to have an odd number of columns at the end of the naos; and cites the temples of Minerva at Athens, of Apollo at Bassæ, of Jupiter Olympius at Agrigentum, of Apollo at Miletus, and of Ceres at Eleusis, for which latter he suggests a restoration.

Since the preceding remarks were written, notice has been taken of the promise made by BÖTTICHER, *Der Hypæthral-tempel*, 4to., Potsdam, 1847, which was his reply to the theory advocated by Ross, to supply within a year his idea of the manner in which the statues were protected; and this, as given in pl. 23 of his work, *Die Tektonik*, 4to., Potsdam, 1844-52, appears to have been a slightly corbelled prolongation of the rafters over the wall of the cella, so that there would be a break or notch in the roof (as would be the case in fig. 5); with a reduction of the area of aperture by a cantilevered cornice to the upper order. This notion of a notch appears in the restorations of the temple to Jupiter at Ægina, and to Apollo Epicurius at Phigaleia near Bassæ, as given in COCKERELL, *Temples of Jupiter Panhellenius*, etc., fol., London, 1860; who, p. 18, observes that the idea of a break in the roof at Ægina is supported by "the discovery of the coping or top stone against which the tiling finished towards the opening, and which is conclusive on the subject. Unfortunately the two fragments discovered were broken at the ends, so that the mode of finishing this member towards the hypæthral is unknown. These stones were nicely cut to receive the upper end of the tiles and covering tiles. But the clearest evidence of the hypæthral opening in the roof is given by the covers of sarcophagi, formed in imitation of temples." He then refers to the example at Cyrene, A, being a tomb probably about 20 ft. long by 6 ft.



wide, and 8 ft. high from the ground to the ridge, as given by BEECHÉY, *Expedition to the Northern Coast of Africa*, 4to., London, 1828, pl. xi; and also to the example at Rhenea near Delos, B, which is given in the supplementary volume to STUART and REVETT, *Antiq. of Athens*, fol., London, 1830, by KINNARD, whose suggestion that the holes were intended as sockets for statues may be set aside by the corresponding example from Crete, C (from a rough sketch), now in the British Museum, where the hole near one end, on the face here shown, is repeated in the back slope equally near the other end: there is no sign that these latter holes were filled by plinths, which moreover would be expected to have been placed as saddles on the ridge. These holes are also much deeper than would be required for that purpose; and are evidently only to be explained by the unique fragment of a tile found in the ruins of the temple to Apollo Epicurius, and published by its zealous explorer COCKERELL, in pl. vii, figs. 2 and 5, of his *Bassæ*, as above cited. The importance of this fragment has not been sufficiently appreciated even by its fortunate discoverer. Upon due restoration, it appears to have formed part of a perforated tile, formed with its covering tile out of one piece of marble, as shown in the illustrations s. v. IMBEX. It consequently gives

positively, like fig. C, one mode of dispensing with a notch in the roof of a hypæthral temple; while figs. A and B exhibit another system. Both must be later than the contrivance which Mr. Cockerell thought was indicated by the curb-stones that, as given by him in pl. vi, figs. 4, 5 and 6, of his *Ægina*, present discrepancies which have hitherto defied earnest attempts at making them suitable either to each other or to the rest of the work of the roof.

J. W. P.

HYPAETHRI LUMEN. These words have been adopted by SCHNEIDER instead of hypothyri lumen in the text of VITRUVIUS, iv, 6. The fact that, in the shape of *hypetri* or *hypetri*, hypæthri occurs in that place in seven manuscripts in the collection at the British Museum, as well as in the first edition, has been noticed by DONALDSON, *Ancient Doorways*, 4to., London, 1833. He suggests that as the words lumen hypæthri are immediately followed by "lumen valvarum", the former must mean a void portion of a doorway very different from that which was intended to be closed by the door. Although the remainder of his translation of the text does not seem to furnish determinate dimensions for the upper "lumen", it must be admitted that his idea of a clathrated light placed between the transom and the lintel is supported by the authority (whatever that may have been) for the manner (better shown by DONALDSON than by TAYLOR and CRESY, *Arch. Ant.*, fol., London, 1821) in which the doorway of the Pantheon at Rome is at present filled; and by a cast in the British Museum of a bassorilievo of Venus with a hare, at the villa Albani at Rome, but this portion is not given by ZOEGA, *Bassi-rilievi*, fol., Rome, 1808, ii, pl. 112.

HYPERBIUS, see EURYALUS.

HYPEROUM (Gr. ὑπερῶν). This term, which occurs in the Acts xx, 8, is usually translated by *canaculum*, as by BINGHAM, *Origines*, 8vo., London, 1840, ii, 364-5; and by *upper story*, as if it were the *δῆψες μελάθρων* or *double floor* of EURIPIDES, *Phœn.*, 90. In the *Iliad* and the *Odyssey*, in which the word is frequent, the upper floor where the women dwelt is meant. In ARISTOPHANES, *Equites*, 996, and *Plutus*, 811, it seems to have been a place for stores. The frequent use of this phrase would lead to the belief that the Greek houses were not built so much on one floor as is generally considered; and as the roofs were nearly always flat or terraced, these rooms could hardly be garrets. The hyperoum must sometimes have been a large room, for in the Acts i, 13, the apostles with the women and the brethren, in number about one hundred and twenty, assembled in such an apartment. In the Acts first quoted, the same word is used for a similar place of assembly; but in the next verse it is called *τρίστηνον*, the third story, or, as the authorized version reads, the third loft, for *stega* (Gr. στέγη) signifies a roof, a place roofed over, a chamber, a tent (SOPHOCLES, *Ajax*, 108), and also the deck of a ship. ΜΕΛΑΘΡΟΝ (Gr. μελάθρον) is an analogous word. STEGE. A. A.

HYPERTHYRUM (Gr. ὑπέρθυρον) and HYPERTHYRIS. These words occur in VITRUVIUS, iv, 6, who clearly applies the first specially to the frieze (inclusive of a Doric cymatium and Lesbian astragal) between the architrave and cornice of the dressings to a doorway; and also in a general manner to these three members of the dressings. The remarkable dogma of this author that the top of the cornice should range with the underside of the architrave of the pronaos, is illustrated in the temple at Cora. HOMER, *Odys.*, vii, 90, uses ὑπέρθυρον where this diminutive is supposed to mean merely a cap-piece, cross-piece, king's-piece, or lintel, to the aperture of a doorway. SUPERLIMINARE. I. 2. 4.

HYPOBASIS (Gr. ὑπόβασις). A secondary, or lower, base.

HYPOCAUSIS and HYPOCAUSTUM. These two words appear to have been usually translated as meaning the same thing, viz. the network of channels by means of which the ancients conveyed hot air under a floor. But SCHNEIDER, altering the received text of VITRUVIUS, v, 10, "ut in vasariis

hypocaustis communis sit usus eorum utrisque" in a manner which requires defence, has cleverly suggested that *hypocaustis* was the place where the fire was kindled, and *hypocaustum* was the floor or cell filled with air, and therefore heated by that kindled fire. His alteration of the subsequent words 'ænea supra hypocaustum' into 'arena supra hypocaustum' also requires defence if the term *hypocaustum*, written across the network of channels filled with flame, in the section given in a painting discovered in the baths of Titus (BATHS, etc., fig. 2, p. 6), be accepted as an authority strengthened to some extent by the words of STATIUS, *Sylo.*, i, v, 59, "tenuem volvunt hypocausta vaporem". It seems probable that the suggestion of *hypocaustis* for 'furnace', and of *hypocaustum* as equivalent to *suspensuræ (cellarum) caldarium*, for 'apparatus', is correct; as VITRUVIUS, in a following passage, has "testudinesque alveorum ex communi hypocausti caleficientur", and "solum sternatur inclinatum ad hypocaustum uti pila—redeat ad præfurnium", where *præfurnium*, like *propigneum* in cap. ii, should be translated by 'stokehole'. The author last named describes the construction of the apparatus as a floor of 24 in. tiles laid on brick piers 8 ins. square, built with lime and hair mortar, which he says are to be 24 ins. high: 30 ins. for private, and 36 ins. for public, baths have been recommended. Plans and sections are given in *Detached Essays*, BATHS, etc.; and by HAKEWILL, *Roman Villa at Northleigh, discovered 1813-6*, 4to., London, 1826, first given in SKELTON, *Oxfordshire*, fol. It should not be forgotten that in the terms *diæta hypocaustæ* of ULPIAN, *Dig.*, xxxii, 53, and *unctuarium hypocaustum* of PLINY, *Ep.*, ii, 17, the word seems to be used adjectively to show that artificial heat was employed.

FRANKLIN, *Smoky Chimneys*, 8vo., London, 1787, p. 51-2, states that the Northern Chinese warm their ground floors, which are formed of foot tiles 2 ins. thick, the corners supported by bricks set on end, 1 ft. long and 4 ins. square; the tiles connected with each other by ridges and hollows along their sides; a fire is made on one side of the house, and a funnel on the other to carry off the smoke. But he recommends erecting a funnel close to the grate, so as to have only an iron plate between the fire and the funnel; through which plate, the air in the funnel being heated, it would be sure to draw well, and the smoke would be forced to descend through the fire to the right and left into channels or passages under the floor, until it arrives at the aperture in the funnel. The flame being divided from the grate, very little of the heat would be lost, and a winter room would be thus rendered comfortable.

HYPOCHORESIS (Gr. ὑποχώρασις). This term, which occurs in a Greek inscription at Apollonia in Bithynia, is translated "recess or passage" in WALPOLE, *Memoirs*, 4to., London, 1817, p. 457.

HYPODROME (Gr. ὑπόδρομος). This word, which would mean a covered place for a walk, has been suggested instead of *hippodromus* in PLINY, *Ep.*, v, 6, and SIDONIUS, *Ep.*, ii, 2.

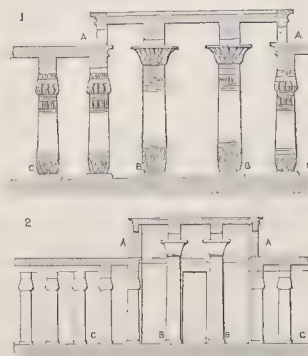
HYPOGÆUM (Gr. ὑπόγειον) and **HYPOGEUM** (Gr. ὑπόγειον). A term applied by the ancients, as in VITRUVIUS, vi, 11, to a room placed below the level of the ground, such as those belonging to the amphitheatre at Herculaneum, described by the REALE ACCADEMIA EROLANESE, *Memorie*, 4to., Naples, 1852, iv, part i, 240. The term is used for vaults or catacombs, whether holding urns (it must be recollected that the system of burning was exceptional) or coffins; the hypogæum corresponding to the COLUMBARIUM as well as to the CONDITORIUM. It is not necessary that a crypt should be subterranean; but a hypogæum must be underground. Some hypogæa are entered from a well, like the tomb near Sidon, and the tombs of the kings at Jerusalem, given in CASSAS, *Voy. Pitt. de la Syrie*, fol., Paris, 1798, ii, 82, iii, 19-23. Consequently a large number of the tombs in Egypt, such as those at Benihasan, Saouadeh, and El Marteyn, of which sections are given in *Description de l'Égypte* (Antiquities), pl. i, 3, 4, and 5, text i; are not caverns, nor grottoes, nor crypts, but

proper hypogæa (an example at Alexandria is given in the *Illustrations*, s. v.); and such are the places described by DUBOIS DE MONTPEREUX, *Voyage autour du Caucase*, 8vo., Paris, 1839-43, v, 184, at Kertch (Panticapæa); and vi, 165, at Cherson: those mentioned by him vi, 307-15, at Tépékerman, may have been originally dwellings, like those that have been excavated, lined with masonry, and stuccoed, at Chitteldroog.

HYPOPODIUM. A second or lower podium.

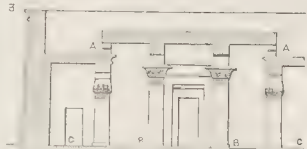
HYPOSCENIUM (Gr. ὑπόσκηνον). The meaning of this word is so uncertain, that DONALDSON (in STUART and REVETT, *Antiq.*, supp. vol., fol., London, 1830, p. 41), after stating that it was the stage on which the principal performers, or *scenici*, only recited; to which stage there was an access from the *thymel* by means of stairs, adds that at the time of the general assemblies of the citizens upon public affairs, the *logeion* was occupied by the orators. He further says that the hyposcenium was composed of the *logeion* and *proscenium*; the elevation of which, towards the audience, was adorned with enrichments of columns, niches, and statues. Here he must evidently be speaking of the decoration of the front of the *logeion*, not of the *scene* itself. Some writers, depending upon SUIDAS, s. v. σκηνή, have supposed the hyposcenium to be the *conistra* as a portion of the orchestra; or the green-room; or else the space, under the floor of the *logeion*, which was in most theatres of wood, though sometimes formed of blocks of marble. In the large theatre in Pompeii, the podium of the stage had seven recesses, similar to others discovered at the theatre in Herculaneum; and this decoration (whether to receive statues or musicians is architecturally unimportant) may induce the suggestion, that the *hyposcenium* was really the wall supporting the *logeion*, *pulpitum*, or *proscenium* of the stage in the ancient theatre, which agrees with JULIUS POLLUX, *Onomasticon*.

HYPOSTYLE (Gr. ὑπόστυλος, work supported by columns: the term τὸ ὑπόστυλον is used by PHILO JUDÆUS for a covered colonnade or a pillared hall). A word used by DIODORUS SICULUS, i, 47-8, to define one of the halls in the sepulchre of Osymandyas in Thebes. This author, describing the edifice, relates all the circumstances as to the first and second courts and their statues, of which ample remains exist at the present day to make out the plans, and thus verify his accuracy. He then states that there are three entrances which lead into a hypostyle hall (οἶκον ὑπόστυλον), and gives its dimensions and an account of the statues therein. The word 'hypostyle' seems to have been revived by CANINA to express a great peculiarity in these halls, which are filled with columns carrying a flat roof, the middle rows of which are loftier than the others and afford a side light, as is shown below. These peculiarities seem to have escaped Sir G. WILKINSON, and in fact all modern writers on the subject previous to CANINA. Fig. 1 shows the hall in question as described by DIODORUS. It is lighted by two ranges of windows A A, which receive lateral light between their own roof and that adjacent to it. The two middle ranges of columns B B, are



higher than those in what may be called the side aisles C C, so that the middle of the building is lighted in a manner somewhat analogous to the clearstory of a cathedral. Fig. 2 shows the like section across the great hall at Karnac; and fig. 3 that of the smaller hall at the same place. The letters refer to the same points in all the

woodcuts. The use of these edifices seems doubtful: a hall further on in the same building is said by DIONORUS to have been used as a library. The altars for public worship seem to have been in the



outer and inner courts, and not in these halls, which were probably intended for royal assemblages, banquets, etc.; CANINA, *Architettura Egiziana*, ii, 77, 84, 86, etc. A. A.

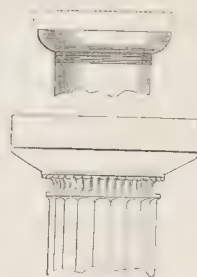
The term 'hypostyle' having been resuscitated (whether by CHAMPOLLION or by CANINA is not important), it has a distinct architectural meaning; and it expresses shortly, as appears above, that such a work is filled with columns carrying a flat ceiling. It is curious, however, that the word is still employed loosely and even erroneously in professedly critical works: thus in FREEMAN, *History of Architecture*, 8vo., London, 1849, p. 73, mention of an apartment "next to the portico and entered from it by a doorway; this is a hypostyle hall with columns supporting a flat roof of stone", is followed by the extraordinary remark that the "propylæa lead into a large open court in front of the temple, calling to mind the western cloisters of the early basilicas, to which it is exactly analogous; this is *hypostyle* or surrounded by columns, on three sides, the portico itself forming the fourth. The central part is hypæthral, but the pillars support a stone roof connected with the surrounding wall, so as to form a covered passage all round."

HYPOTHYRUM. This word, which was introduced by GIOCONDO into the text of VITRUVIUS, iv, 6, seems to be inapplicable to anything but the sill of a door: and *HYPÆTHRUM* has been very judiciously restored to its place.

HYPOTRACHELIUM (Gr. ὑποτραχήλιον, below the neck, or the lower part of the neck). This term, as employed by VITRUVIUS, iii, 2, "contracturæ autem in summis columnarum hypotrachelis"; iii, 3, "contra epistylia columnarumque hypotrachelia", and iv, 3, "epistylia latitudo ima respondeat hypotrachelio summæ columnæ"; means the least width, whether of a column or of an architrave; the It. *restremamento*; Fr. *rapetissement*, *retraite*, *retrécissement*, would be proper translations of the word: but these are meant to apply to the apophysis, in which sense the Italian commentators understood VITRUVIUS, although they allowed that the term also meant the space between the echinus and the astragal.

In consequence of the passage iv, 7, giving the proportions of the height of the capital of the Tuscan order as follows,

"partes tres, e quibus una plintho quæ est in abaco, altera echino, tertia hypotrachelio cum apophysi", coupling with it



part of a previous sentence "torum cum apophysi", it is clear that the author meant by hypotrachelium a space either plain, or reeded, as in the upper illustration; or ornamented as in the lower one. His corresponding description of the proportions of the height of the capital of the Doric order, iv, 3, viz. "partes tres, e quibus una plinthus cum cymatio fiat, altera echinus cum annulis, tertia hypotrachelion", suggests that the space, in Greek examples, between the annulets of the echinus and the top

bed of the shaft was the hypotrachelium. The grooved work above that bed was considered a part of the hypotrachelium by COCKERELL, *The Temples*, etc., fol., London, 1860, p. 15, who observes that old examples have three grooves in the hypotrachelium rather than one, the latter being most modern. At Cora a sort of hypotrachelium is produced by the stoppage of the flutes at a short distance below the annulets. Modern writers have restricted the meaning of this word to a single feature, viz. the "frieze or neck" (so called by CHAMBERS, *Civil Arch.*, fol., Lond., 1791) of the shaft of a column of the Tuscan, Doric, or Ionic, order, being that part of the shaft which extends from the real neck or underside of the lowest cincture of the capital down to the top of the astragal and fillet. "To the hypotrachelium with astragal and fillet, resemble in Rome the examples considered the Tuscan, in the first order of the coliseum; in the third order" (of the theatre) "at Verona; and in the example with Doric triglyphs to the theatre of Marcellus", INWOOD, *Erechtheion*, fol., London, 1827, p. 70.

HYPSONETER. A small pocket instrument, invented by J. Sang of Kirkcaldy, for measuring the altitude of objects with accuracy, as described in the *CIVIL ENGINEER Journal*, 1840, iii, 403, and iv, 10.

HYRE (. . . DE LA). Two members of this family practised at Paris, where the elder one was elected 1687 into the academy of architecture, and died 1718. His son was elected 1706 into that body; but his death has not been ascertained.

HYSPLENX (Gr. ὑσπληγξ, ὑσπληξ). The rope across the starting place in a stadium; and not the starting place itself, as sometimes asserted, apparently because *carcer* occurs in the translation of JULIUS POLLUX, *Onomasticon*, iii, § 147.

H E A T .

HEAT, as required in architectural structures, results from raising the temperature of the air in an apartment, or suite of apartments, by means of various contrivances, so arranged as to take advantage of the laws which govern the transmission of heat.

It is unnecessary here to enter into a statement of the various theories promulgated regarding the nature of heat; a subject on which there is still very great diversity of opinion; but the principles which govern its movements, on whose due adaptation effective heating alone depends, must be briefly pointed out.

A body capable of affording heat, gives out caloric by two methods; these are radiation and conduction. Radiant heat is diffused through the air at an immense velocity, without materially raising its temperature, but immediately warming solid bodies exposed to its influence; its effect being increased in proportion to the number of points which a body presents to its influence: hence it is more rapid on rough surfaces than on smooth ones: the sun, fire, candles, gas, all give out radiant heat. In an apartment warmed by an open fire, the heat thrown out raises the temperature of the surrounding bodies, which, in turn, give out the acquired heat slowly. High temperature is required in bodies ere they can throw off much radiant heat; the redder the fire in an open fire-place, the warmer is the radiant heat; it follows then, that bodies at a low temperature, *i. e.*, below 212° , afford very little heat from radiation. Radiant heat is unequal in its effects; some parts of the body may be over-warmed by it, whilst others may be cold; moreover it can only be used on a small scale. If large fires be kept up to raise the temperature of a room, the heat near them is too great, diminishing as the square of the distance, to positive inefficacy. The attendant disadvantages of a number of fires are too obvious to be more particularly indicated.

When, therefore, the air of a large apartment is to be raised in temperature, the method of heating by contact is employed. The name sufficiently indicates the principle; for the volumes of air, coming in contact with the heated surface, become raised in temperature, are put in motion, and communicate the heat they receive to surrounding bodies.

The quantity of air, which may be warmed, will depend upon the area of heating surface; as only a certain volume of air can come in contact with a given space at one time. In order to obtain full advantage of heating surfaces, their area should be proportioned to the cubic feet of air required to be warmed; a small surface, if raised to a very great temperature, will heat a large quantity of air, if means are taken to pass it rapidly from contact with the heated surface: it is most advantageous, however, both on account of health, and economy of working, to have a large surface maintained at a mild temperature with a slow, but gradual, change of air. When the air comes in contact with a body greatly heated, it is rendered unhealthy by being deprived of its moisture, or being burnt as it is termed. In general if the temperature is above 212° , or that of boiling water, this effect is produced.

It will be seen that a movement of the air to be heated is an essential requisite in effective heating: in fact, a large body of air cannot be raised in temperature, unless its movements are assisted and sustained by ventilation. If air around a heated body be, in some measure, forced to be quiescent, only the portions immediately in contact with it are heated; air being a

very bad absorbent, it only communicates or conveys heat when allowed to have free motion among the particles of surrounding volumes: a costly and complicated apparatus has proved totally ineffective, solely through want of efficient ventilation.

As the movement of heated air is upwards (VENTILATION), it is obvious that the best place for the situation of the heating surface is near the floor of the apartment to be warmed, if possible beneath it. The air to be raised in temperature should have free access to it, and be allowed to flow freely upwards to the interior of the apartment. It is, therefore, manifestly erroneous to have, as is often the case, the heating surfaces, as steam, or hot-water pipes, hung within a few inches of the ceiling of the apartment. If the room be well ventilated, in which this plan is adopted, the warmed air will at once be passed from the apartment. If there be no means for ventilation, the parties occupying the room will be warmed only after a considerable lapse of time. The foregoing remarks being once thoroughly understood, there will be no difficulty in applying the various methods which are hereafter described.

In the present article will be mentioned, as concisely as the subject will admit, the various modes of heating generally adopted; by which advantage is taken of the principles already indicated—"radiation" and "conduction". These are, first, open fire-places, or Heating chiefly by radiation; secondly, high temperature stoves and furnaces, steam and hot-water pipes, or Heating chiefly by conduction or contact.

The most primitive mode of heating the air in apartments used by man was, in all probability, by consuming masses of wood, placed on the ground, in a central position of the room; the smoke being allowed to pass through the *entrance* aperture, or through one specially made in the roof. This is still the mode in use amongst the savage tribes of the American continent, and of other countries, and is even to be seen in the Highlands of Scotland; in many parts of Spain charcoal is burnt, in open braziers, in the rooms required to be warmed.

This mode of consuming the above species of fuel is of very ancient origin. In many of the religious ceremonies of the Greeks, the open brazier, filled with perfumed fuel, was generally employed; and, from using it thus, the transition to domestic purposes may have been sufficiently obvious to have induced the latter practice; for their apartments were warmed by burning fuel in like manner. Whether the method was anteriorly adopted for ceremonial purposes matters not, it is sufficient to know that it was the general practice for domestic convenience; the noxious fumes arising from the fuel being corrected, or at least disguised, by the addition of spices and perfumes. In Rome a similar system was in vogue; the receptacles for the fuel being, in some cases, of a costly and handsome construction. This antiquated mode of warming is not quite extinct; it has been employed for heating the entrance halls of places of amusement, and, in some cathedrals, it may still be seen in operation. A kindred usage, moreover, may be traced in the turf-hearth of too many of those dark, low-roofed hovels, remaining in the poorer districts of Scotland and Ireland.

In heating apartments, the Romans adopted another method, in addition to that described above; the principle of which has been adopted in the constructions of modern times. In this,

called the "hypocaustum", the rooms are heated by flues running under the floors, in some cases, supplied with heated air from a fire outside the building; in others the hypocaust was formed by a low chamber beneath the floor; the roof of which was supported by "small pillars, or by dwarf walls, and sometimes with flues leading from them to other apartments." (TOMLINSON, *Rudimentary Treatise on Warming and Ventilating*, p. 53; VITRUVIUS; ADAMS, *Roman Antiquities*.) This plan, as above hinted, has been introduced in modern times, in hot-houses and other structures, and is largely practised by the Chinese.

Previous to the fourteenth century the apartments, even of the wealthy classes in Europe, were heated much in the same primitive manner. The fuel was burnt on an open hearth, in the centre of the apartment; the smoke, created by the combustion of the masses of wood which formed the fuel, escaped through an opening in the room, so arranged that while the smoke escaped, the wind and rain were prevented from entering. This contrivance, termed the "louvre", is still retained under the same name, in many structures of the style to which it is considered more especially to belong; the only mechanical aid to the combustion of the fuel, in such a mode of heating, being a horizontal bar, resting at either end on uprights, designated, as a whole, "andirons". The ends of the billets of wood placed on this, being raised from off the hearth, the circulation of the air, beneath and around them, promoted vivacity of combustion: for the manipulation of the wood, a large two-pronged fork was used.

On the introduction of chimneys (CHIMNEYS), the next obvious improvement took place; the fire, instead of being on the hearth in the centre of the hall, was removed to a recess wall of the apartment. The andirons were, however, still retained; and these, in the halls of rich families, were handsomely constructed; the standards, in some instances, being of silver. The recess, or receptacle in which the hearth was placed, was usually of large dimensions; seats being formed around it, on which the inmates reclined, enjoying the heat and comfort of the cheerful blaze.

The transition from the andirons to the grate, or "cradell", as it was long called, was the next alteration. The large recess, or rather apartment above described, was only eligible in capacious halls; so that when smaller chambers began to be heated, it was much diminished in size. The andirons were then fixed into the back by bars; and, in some cases, these were removable at pleasure; in this arrangement the horizontal billet bar represented the front bars, and the sides of the recess, the jambs, or covings of the modern grate.

The improvement following this was, probably, the bending of a few bars into a semicircular, or rectangular form, and the ends fastened into, and supported by, the back wall of the recess. In the chambers once occupied by Mary, Queen of Scots, in the palace of Holyrood, in Edinburgh, may still be seen an old grate, or cradell, somewhat in this style; and which, according to tradition, was first introduced into Scotland by that princess. TOMLINSON mentions (p. 64), that, in an inventory, dated 1603, of the goods of Sir Thomas Kyston, of Hengrave Hall, Suffolk, there is mention made of "a cradell of iron for the chimney, to burne sea-coal with."

So long as wood was plentiful as a fuel, coal was rarely used; indeed, on its first introduction it had to contend with deep-seated popular prejudices, and judicial penalties, enforced by government against those, who attempted to use it: but on the construction of fire-places being improved, so that the smoke was carried off from the apartment with some degree of certainty, the advantages of coal were soon appreciated.

Early in the seventeenth century, Savot succeeded in effecting decided improvements in the construction of fire-places. The principal defect complained of in the grates placed in small chambers, was, that a door, or window, had to be left open to supply the fuel with air; or the consequence was, that the smoke was driven into the apartment by the air descending the

chimney to the fuel. Savot's mode of obviating this difficulty was, by lowering the mantel, raising the hearth, and constructing the width between the jambs, so that the orifice of the fire-place was left three feet square. From this period till the early part of the eighteenth century, little attention appears to have been paid to the subject.

About the year 1713 a book was published in France with the name attached of GUAGER; who, according to TOMLINSON, (*Rud. Treat. on W. and V.*, p. 70), was the celebrated Cardinal Polignac. The cardinal, however eminent the position he attained in his more peculiar walk, shewed that he fully understood the principles upon which effective heating was to be obtained by the open fire-place. The value of the book (some of the details of which will be hereafter given) may be known from the fact, that almost all who have, since that time, given their attention to the subject, have helped themselves liberally to his ideas, without being, in many cases, equally eager to acknowledge the source of their information. The celebrated DESAGULIERS translated the cardinal's work, and published it in London in 1716, under the title of "Fires Improved, or a New Method of Building Chimneys, so as to prevent their Smoking; in which a small fire shall warm a large room, much better than a large one made the common way. And the method of altering such chimneys as are already built, so that they shall perform the same effects. Second edition, 1736, with an appendix, containing several further improvements, made by the translator and others."

Notwithstanding the admirable hints thrown out in this work (to which the reader, curious in this matter, is referred); the practical hints of Dr. Franklin, given ninety-five years ago; those of Count Rumford, published some years later; and the many valuable suggestions of scientific men of the present century, it is matter of surprise that so many defectively constructed fire-places should still be in daily use. In treating of this part of the subject it is thought best to notice, in detail, the principles on which grates ought to be constructed.

The history of the introduction of the open grate has been already glanced at. In many mansions, and first-class houses, specimens of this mode of heating are to be met with, in which it is difficult to say whether the beauty of design, or elegance of finish, is more noticeable than the excellent arrangements, adopted to secure the full heating effect of the fuel consumed. In these the principles of effective heating are carried fully out; so far, of course, as the peculiarities of the system are capable of improvement. This state of matters, unfortunately the exception not the rule, has been brought about solely by the devotion of their talents by savans to the subject, and by the careful attention which professional men now pay to such matters.

In the fire-places of modern apartments in this country, grates are almost universally used. The object in all such being to heat the lower portion of the hearth and surrounding substances, the bars should be placed very low. The consequence of this arrangement is, that the floor and hearth being warmed, the cold air, which flows into the apartment in contact with them, is warmed by the ascending currents of heated particles. There should be provision made for admitting fresh air to the front of the fire bars, not beneath them; as radiation is chiefly required from the front, the fuel there will be more quickly consumed by the fresh air thus thrown against it. Another beneficial advantage derived from the use of this contrivance, or "blower", as it is called, is, that the currents of air along the floor, found in all apartments not having this plan, are dismissed. In Fig. 1, shewing the arrangement, the grate is indicated by *a*, the air-flue entrance at *b*, the position of the egress aperture, or blower, at *c*.

The materials of which the bodies of grates are generally made militate very much against economy in their use; the desideratum is to have the fire surrounded by non-conducting materials. Iron should be sparingly used in parts near the fuel,

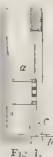


FIG. 1.

and never allowed to surround the place in which it is actually consumed. Some manufacturers content themselves with leaving an aperture at the back of the grate, on casting it, to be afterwards filled in with fire-brick: this is an approximation to what should be the law, yet it is not carried out to its fullest extent: the sides also should be filled in with fire-brick. A form of grate in which the fuel is carefully surrounded on the sides and back, by good non-conducting material, is that known as the "fire-lump grate": such non-conducting bodies could be easily applied to any size of grate, by taking a model of its interior

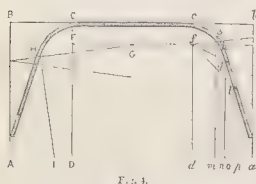
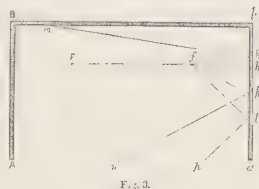


with a piece of block-tin. Fig. 2 is a plan of this body, having the sides at a proper angle at the back. In some grates, where the internal dimensions are too large, malleable iron

sides, or "cheeks", are used to lessen the space, and save the fuel; the above non-conducting body might for this purpose be substituted with advantage. As before mentioned, the chief effect derived from grates, as generally used, is from "radiation". It is, then, of importance to construct them so as to have as large a surface, of burning coal, as possible presented to the interior of the apartment to be warmed. This will be best attained by making the breadth and depth of the front as large as convenient; while the breadth, from front to back, should be of the least dimensions, consistent with the space requisite for steady combustion. A good proportion was found, where the breadth, from side to side of the front bars of the grate was fourteen inches, the depth, from the top to the bottom bars ten inches, and the width, from the inside of the top bar to the back of the grate, was six, but at the bottom, four inches. (GRATES.)

In order that the rays of heat may be readily and surely sent into the room, the sides, or covings, should be made at a certain angle, or curve to the back. The form in which the sides are at right angles to the back, is the one worst calculated to throw out the rays of heat: GUAGER demonstrated very clearly the disadvantages of this form.

"Supposing", says he at page 4, "the fire f , Fig. 3, in a common chimney, whose sides, or jambs AB ; ba are parallel to each other, the ray of heat, fg , will be reflected to m , the ray of fh upon itself into i , the ray fk into n , and the ray fl into p ; and as the ray fl , going from f to l , constantly rises, as it does also when, after reflection, it goes from l to p , it must get within the flue before it reaches p ; and then, whenever it strikes against the fore part of the funnel which is inclined to the horizon, it will be reflected upwards into the chimney; always supposing the angle of incidence to be equal to that of reflection; and therefore it cannot go into the room. He next demonstrates the effect of having sides with a parabolic curve. "Geometry teaches us that all rays which, coming from the focus of a parabolic curve, strike upon its sides, after reflection, go on parallel to the axis. If, therefore, on the back part of



the hearth of the chimney $ABba$, Fig. 4, the length cc , be taken equal to the length of the wood to be burnt, as for example 22 inches; and from the points c , the perpendiculars cd , cd , be drawn for the axis of two half parabolas, whose vertices shall be at c and c ; and the distance of the breadth of the chimney be two points of the said parabolas, then if those parabolic jambs cca , be covered with plate-iron, brass, or copper, and the under part of the chimney-piece be made parallel to the horizon, and as broad as may be, leaving only 10 or 12 inches for the passage into the

funnel: this chimney will not only reflect a great deal more heat than common chimneys, but as much heat as any chimney possibly can do. For if f be the two foci of the half parabolas, when the billets, whose length is supposed ff , are on fire, the rays of heat darted from the said foci ff , which in common chimneys cannot go into the room, and so are useless, will here be reflected parallel to the axis cd to mnp , and consequently go into the room. If the rays, which come from any part of the fire between the foci of the parabolas, be examined, it will appear that though they are not reflected from the jambs in such a manner as to go on parallel to the axes cd , yet they will all be reflected into the room as cn ." (Page 7.)

In some cases it may be deemed desirable to improve old-fashioned grates; this may be done by bending round, and placing in the inside of the jambs, plates of metal in the form of a parabola. As the curve is somewhat difficult to describe, it has been found that nearly equal advantages are to be obtained by having the sides, as drawn in Fig. 2, at an angle of 135° to the back. Count Rumford was the first to introduce this form.

The material of which the covings should be made is of importance. Absorption of heat is the point to be avoided, reflection that to be promoted. Iron absorbs heat rapidly when rough, and radiates little, or nothing, when below the temperature of red heat. Non-conducting materials, as brick, mortar, earthenware, absorb radiant heat very slowly. The nature of the surface of the material employed exercises an important influence on its reflecting powers: polished surfaces absorb little heat, but reflect powerfully; white surfaces reflect better than black, and if rough, less than when smooth. To meet these implied conditions, earthenware, with polished light coloured surfaces, will be the best material to be employed: it will be as perfect a covering as can be obtained, and may be looked upon as the standard of efficiency. The colour may be cream, pale blue, or green; but the nearer it approaches to white the better. To prevent all obstruction of radiation from the burning fuel, the bars should be made as light as consistent with the required strength; and all heavy ornaments thereon should be carefully avoided.

The proportion of the front of the grate to the size of the room, TREDGOLD (*The Principles of Warming, etc.*, § 177, 8th ed., Lond., 1836) gives as follows: "if the length of the front of the grate be made one inch, for each foot in length of the room; and the depth of the front be half-an-inch, for each foot in breadth of the room, the proportions will be found near the truth in the cases usually occurring in practice. If the length of the room be such as requires the grate to be longer than two and a half feet, two fire places will be necessary; and in that case the same proportions may be adopted, divided into two grates: unless the room be very wide, when a greater length should be given, and less depth, so as to preserve an equivalent area."

Grates should not be placed too far in, under the mantel-tree; the outside bars may be flush with the outside of it. The practice of making the recesses for the reception of grates deeper than absolutely necessary, should be at once condemned. The form of grates almost invariably used, is that known as the "register", or similar construction. These, when placed in their receptacles, leave a large empty space between the back and the wall; this often having direct communication with the flue above, serves the purpose of a deposit for all falling soot, which accumulates until it reaches that part of the back of the grate which is apt to be—in fact, is generally—highly heated, and combustion ensues. It may be objected, that the backs of grates are, in some cases, made of fire-brick; and that, consequently, the heat is not sufficient to cause ignition. Admitting the fact, the inference may be denied: it takes a much lower degree of heat to ignite so combustible a matter as soot, than is generally supposed; and the result of all experience proves that this is the case. Again, sparks may be carried up the chimney, and fall down amongst the soot; but all objections to an unlimited condemnation of the practice of leaving spaces behind grates,

are but poor and lame excuses for not getting rid of the absurdity. The use of a flue is to carry off the created soot, and that of a fire-place to heat the room; it is, therefore, as unphilosophical in principle, as inducive of danger in practice, to allow spaces to be left for the reception of that which has no right to be there; or to construct grates in such a manner as to make it a possibility that inflammable substances near them may be ignited.

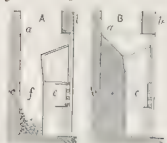


Fig. 5.

Fig. 5 will illustrate the proper form of construction of the recess which should be provided in apartments, for the placing of the grates: A shows the method too much in general use for old chimneys; c, the back wall; b, the wall of the apartment; e, the grate; f, the receptacle behind, having free communication with the flue a.

n shows the plan recommended; c, is the back wall; e, the grate, closely placed in contact with the brickwork f, the shape of which should be that of the back of the grate. Iron chimney-bars, or bearers, ought always to be used in preference to those of wood; for one of the great desiderata to be attained in the construction of fire-places, is the complete isolation of all the parts from the rest of the materials composing the edifice; and it need hardly be said, that the farther all wood-work, whether plastered over or not, is from the grate or flue, the better. All the joints should be carefully cemented; and, if double brick-work be employed, the joints should break one with another.

The chimney vent, at its lower end, should communicate with the fire-place only, so that descending soot must of necessity fall into the grate. At the place where the flue commences, immediately above the grate, a valve opening upwards should be placed; this may be made of sheet iron, hinged at one side, similar to the register of improved grates. If a similar valve be placed near the exit-aperture of the flue, in the event of the soot therein igniting, the fire may almost instantly be extinguished by shutting it, as also the lower one; thence no air gaining admittance, combustion will soon cease to act. Should it be inconvenient to place this upper valve in or outside the roof, it may be opened and shut by a rod passing down the flue, and continued, for a short distance, in the interior of the grate; an aperture being made in the dome or top of the grate to admit of its passage.

Before describing plans for the economical arrangements of grates, so as to derive full advantage from the fuel consumed, it will be necessary to point out, very briefly, the forms in which the heat generated by combustion exists, and then to see how it is communicated to those bodies which are warmed. The heat generated by the fuel exists under two forms, "combined" and "radiant". The radiant heat, as already shown, is influential in raising the temperature of bodies only when it is stopped or absorbed by them; it never raises the temperature of the air through which it passes. Combined heat is communicated to bodies by actual contact. The radiant heat from the fuel in the grate depends, for its efficiency, upon the surface of red, clear, burning fuel in the front, towards the room. The combined heat goes off, in the form of smoke and heated air, to the atmosphere.

A point of considerable importance has often been mooted in this way: "What proportion does the radiant heat bear to the combined, produced in a grate as commonly constructed?" Though this point has not been determined with any considerable degree of precision, it is, however, quite certain that the quantity of heat which goes off, combined with the smoke, vapour, and heated air, is much more considerable—perhaps three or four times greater, at least—than that which is sent off from the fire in rays; and yet, small as is the quantity of this radiant heat, it is the only part of the warmth generated in the combustion of the fuel burnt in an open fire-place, which is ever employed, or which ever can be employed, in heating a room." (RUMFORD, *Essays*.)

In attempting to derive the utmost advantage from the fuel

consumed in an open fire-place, the plan generally adopted has been, to pass air in contact with the back and sides of the grate, which, being heated, raised the temperature of the air. GUAGER, in 1713, was the first to describe a very simple and effective plan of heating air by means of a fire-place; and Fig. 6 will amply illustrate the *rationale* of his plan. A chamber was made at the back of the grate or fire-place, provided with a conduit made by a series of flat metal plates, somewhat shorter than the height of the chamber; these were placed at short distances from one another, but commencing from top and bottom alternately. This arrangement left openings in such a manner, that the air was obliged to take a zigzag or circuitous route, so that it occupied a considerable time in passing through the whole extent of the chamber. a is the air-flue leading from the external atmosphere to the interior of the chamber; b b, the flat metal plates; c, the tube leading the air to a grating placed at the side of the chimney-piece, communicating with the interior of the apartment. The arrows shew the direction of the atmosphere when being heated.



Fig. 6.

Instead of leading the air to the apartment in which the fire-place is situated, it may be taken to the one above.

The mode by which the heated air was admitted in any desired proportion, was as follows. Two cylinders were procured, one revolving within the other; the external one having a handle, by which it was moved, passing through the cover of the outer cylinder. In the external cylinder three apertures were cut, and in the internal two. "To fix this double cylinder (Fig.



Fig. 7.

7), the opening m n being placed opposite to the way of warm air from the cavities, let d p be opposite to the passage from the cold air, and l g open toward the chamber. Now when q y is over against d p, only the warm air will go into the room; but if b c be turned over against m n, nothing but cold air will come into the room, for the hole, m n, through which the warm air came, will be stopped; but if the part c were only brought forward to the middle of the hole m n, half of d p would be open; then warm and cold air would go into the cylinder, which would be mixed as they came out through the hole g l; if but a third part of n m be shut, only a third part of d p will be opened." (GUAGER'S *Fires Improved*, p. 106.)

The principle of taking advantage of the heating surface at the back of grates, has been applied to the warming of extra rooms in labourers' cottages with considerable success. The following (Fig. 8) is a sketch of the plan given in the *Report of the Sanitary Condition of the Labouring Population of Great Britain*.

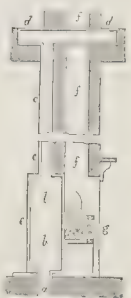


Fig. 8.

a is the cold air pipe, b b the heating chamber at the back of the grate, c c the pipe leading to the rooms above, d d the grating, having apertures in the upper side for the admission of the heated air, f f the chimney-flue, g the grate. An improvement on this arrangement would be effected by making the warm air pass up the pipe in close contact with the flue,—in fact, one side to form the side of the chimney; thus, full advantage would be taken of the smoke and heated air. There would then be no division, as in the shaded part of the figure. The part e of the hot-air chamber in the extra room should be thinner than that at the back of the grate: indeed, the only thing to apprehend in this construction, is the overheating of the air through the thinness of the back of the grate; slabs of earthenware, one inch thick, would answer better.

The cold-air flue in this, and the blower in the other, arrangements shown, should be provided with valves. A method of regulating the supply was thus adopted by GUAGER (p. 108). A small frame was fitted in the hole or aperture made in the

hearth-stone; the edge of this frame not being rebated, but bevelled downwards, so as to prevent the ashes from lying in the frame and preventing the valve from being shut closely down. To this frame a little trap-door was hinged at the side furthest from the fire, and which could be opened by means of a button; the under side of the trap had fixed at each side two sector-shaped pieces of iron; these directed the air, when the trap was open, to the front of the flame; two small springs at each end pressed upon the sectors, and kept the trap open at any desired angle.

To give a list of the names of various grates which have been introduced from time to time, and to point out their peculiarities, would occupy more space than their intrinsic merits deserve. Numerous as have been their forms, the principle has been very nearly the same in all of them; the alterations, or alleged improvements, consisting more in the manner in which the fuel was consumed or applied, than in the alteration or improvement of the heating surfaces. There have been, nevertheless, a few arrangements by which the radiation of the heat into the room has been materially assisted by the admirable arrangement of the parts; those of Sylvester and Joyce deserve especial notice, for as radiant heat is assuredly the most healthy and agreeable, any plan by which the radiation from a common fire-place can be increased, must be a boon of some value to the community.

To these may be added Cundy's patent fire-place, as a grate which is very effective in this respect, from the excellent arrangement of the heating surfaces; Mr. Cundy having wisely discarded all metal and iron as generally used, save for the external ornamentation; in place of it he allows the flame and heated air to pass over, and in contact with, masses of Stour-bridge clay; a material which rarely attains a heat sufficient to burn the fresh air suffered to come in contact with it. The fresh air to be heated passes, along a flue or flues, connected with the external air, into the hot air chambers formed by the clay, and afterward into the apartment. By an excellent arrangement of the clay surfaces, their full heating effect can be obtained in the manner of a well arranged stove, yet the cheerfulness of the open fire-place is still retained. The fresh air gaining admittance from the exterior to the place beneath the fire bars, the fuel is so well supplied with the air necessary for combustion, that, with a well constructed chimney, no fear of smoke entering the room need be apprehended. Upon the whole, this stove, or fire-place, appears to rank as the most efficient, and certainly the most economical, yet introduced. It has all the advantages of Cardinal Polignac's fire-place, with none of the disadvantages attendant upon the materials employed by him for his heating surfaces; and when used in a well ventilated apartment, it has been found to give satisfaction.

The inhabitants of this country have an insuperable objection to close stoves, and perhaps justly so; the cheerfulness of an open fire-place being admitted on all hands. "The light, also, is not to be considered a mere nominal advantage, but a real and positive benefit, affecting the whole system by its physical action, independently of the cheerful impression which its liveliness is calculated to excite, and which, to many, is so engaging, that they feel as if they were not alone when they have the company of a glowing fire. These considerations will probably always sustain the open fire-place in countries where fuel can be procured with sufficient economy" (REID; *Illustrations of Ventilation*, p. 130). But open fire-places, pleasant as they undoubtedly are, are by no means calculated to give satisfaction in so far as the economical consumption of the fuel is concerned; they are creative of much dust, and require constant attendance; it is of importance, therefore, that attempts should be made to improve the construction of the grate, so as to obtain the full effect of the fuel consumed. It is believed that a close attention to the principles herein described and explained, will prove that this is not such a matter of difficulty as is generally supposed.

The second division of this subject, Heating by high temperature Stoves and Furnaces, now comes under consideration.

ARCH. PUB. SOC.

The varieties of stoves are numerous; but the principle upon which they depend for their efficiency is in all cases nearly the same. This may be stated to be the heating of plates of metal, or other quick conducting material, by the combustion of fuel in actual contact therewith; or by the impingement thereon of products of combustion, heated to a high temperature. In the majority of stoves, the air to be warmed, passing over these highly heated surfaces, is burnt, or deprived of its inherent moisture. In some, however, the fuel is so judiciously consumed, that the material confining it is rarely heated to an unhealthy degree: this, however, is the exception. In the following remarks, a brief description will be given of the stoves generally in use; more particularly illustrating those which in principle seem best adapted for creating and maintaining a healthy heat, in the apartments in which they may be placed.

The most simply constructed stove, and that which is much used, is shown in Fig. 9:—*ee* is the body of the stove; *d* is the door by which fuel is admitted; *b*, the pipe or funnel for leading off the products of combustion. The great disadvantage attending this form is, that the air to be heated, by coming in contact with the highly heated external surface, is certain to be burnt. This, it is evident, from the nature of the construction, cannot be controlled with any degree of certainty; and the only mode of restoring the grateful humidity of the air is by placing a basin of cold water on the top of the stove, the vapour from which relieves the dryness. This contrivance should be looked upon as a mere expedient to overcome an evil which ought not, and need not, be tolerated, if proper advantage be taken of the laws regulating the creation and maintenance of heat. One advantage is certainly possessed by this stove, that its whole exterior is an extensive heating surface: the conducting power of iron, of which it is generally made, being great, the temperature of every part is raised very considerably, whether affected by the actual juxtaposition of the fuel or not.

The heating surface can be materially increased, and the full effect of the heated products from the fuel obtained, by lengthening the smoke tube, and retaining this in the room in which the stove is placed: there is a limit, however, to this; as by increasing the length, the draught will be lessened in a corresponding degree. There is no loss of warm air (as in the common fire-place, where much effective heat is carried up the chimney); the air required for combustion being forced to pass up through the lower grating of the stove. The stove thus described, better known as the "cabin stove", although most generally met with, may be considered as the most unhealthy, and faulty form of construction which can be adopted, besides being very dangerous; as the flue and body of the stove, from becoming over-heated, often set fire to surrounding materials.

The most obvious improvement in this form is by surrounding the fuel with a non-conducting substance, and by causing the heated products to pass through a series of passages before allowing them finally to escape; so that the heat may thus be communicated to as extensive a surface as possible. The following arrangement is, in some degree, more satisfactory; the mode of leading the products is similar to that adopted in the Russian and Swedish stoves, to which, in fact, it has much resemblance. *ee*, in Fig. 10, is the body of the stove, made of cast iron; *a* the grating on which the fuel is placed; *cc* a fire-lump casing, placed in the inside of the stove surrounding the burning fuel; *ddd* a series of plates, so placed in the interior that the opening is left at each alternate end; through these openings the smoke and heated products pass, finally issuing through the flue *b*. The Russian stove is generally placed clear of the walls, so that all the surface is used effectively; in some cases it is placed in an aperture communicating with two apartments, thus heating them both. There is no grate in these stoves; the



F

bottom, on which the fuel rests, being solid; wood being generally burnt, after lively ignition has ceased, and the portions completely burnt, the red embers are raked together, when, the door of the stove being firmly shut, and the aperture of the chimney being closed, the heat given out is found to last for a long time. To have the full effect of these stoves, the heated air produced is not allowed to be carried off by ventilation. The products of respiration, etc., are frozen on the windows: when a thaw ensues, the cake of ice melts, and the deleterious gases evolved often produce vertigo and fainting, in those inhabiting the apartment.

The effective heating of a common stove (Fig. 9) may be increased by lengthening the funnel. TOMLINSON (*Rud. Treat. on Warm. and Vent.*, page 105) thus describes the effects of elbows, or bends, on the smoke tubes, as first elucidated by Mr. Bull. It "appears that the same length of pipe is much more efficacious, when it has elbows, in imparting heat to a room, than when it is straight; that a descending current may be somewhat more efficacious than an ascending one, but is about equal with a horizontal one; and that a horizontal pipe, with the same number of elbows, is more efficacious, in imparting heat, than when placed vertically for an ascending, or descending current. The cause of the increased effect is supposed to arise from the shape of the pipe forcing the air to make abrupt turns; in doing which, it impinges against the elbows with sufficient force to invert its internal arrangement, by which a new stratum of hot air, from the interior of the current, is brought more frequently in contact with the sides of the pipe, and particularly with the lower half of the horizontal pipe, which, from various causes, gives out very little heat to the room without the aid of elbow joints. But the advantage gained by increasing the length of pipe, and number of joints, has a limit very far short of that which is found to be necessary to impart all, or the greatest part, of the heat generated, to the air of the room. Only five parts of heat in one hundred were lost by using thirteen and a half feet of pipe, consisting of nine elbow joints; whereas eight additional elbow joints, and sixteen and a half feet additional of straight pipe, in all twenty-eight and a half feet of pipe, were required to save these five parts, and prevent them from flowing into the chimney. By diminishing the diameter of the pipe, the heating effect is increased, partly from the retardation of the current, and partly from the small pipe exposing a greater surface to the air, with the same quantity of smoke, than a pipe of larger diameter."

This plan of making elbow joints, or tubes, will be found only eligible where coke, or charcoal, is consumed: the soot from coal would accumulate so fast, at the turns, as soon to clog up the orifice, and lessen the draught. A tube three inches in diameter, attached to a small stove in constant use, has been found so completely filled up with soot in the course of a week, that a stick, half an inch in diameter, could scarcely be passed through the hole left in the centre.

Cleaning these pipes is always an ungrateful task for servants; of course it is frequently neglected, and often, when a stove is required to act to the most advantage, it will not work at all: it is therefore a question whether stoves, less economical in fuel, would not be found more satisfactory in operation.

Passing over the vast variety of stoves which have been brought forward as new, or perfect in their arrangements, but all of which depend upon the principles herein elucidated, that form which, more than any other, has attracted general attention will now be described: this is known by the name of its inventor, as "Arnott's stove". The principle on which this stove depends for its efficiency is the burning of the fuel very slowly, and the detention of the heat in the stove. The mode on which this principle is carried out, varies in almost every form of the stove which has been brought out; and not in all cases has it been closely attended to.

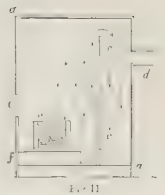
Generally a large outer case is made of iron, and lined with fire-brick, or clay; the fuel being consumed in a grating

placed at the bottom, or in a fire-box within the outer casing. The products of combustion are carried off by a tube, after being made to circulate in the interior casing by means of a partition, disposed as seen in Fig. 11; where *aa* is the outer casing, *b* the fire-box containing the fuel, *cc* an internal partition dividing the casing into two chambers, communicating at top and bottom, *d* the tube by which the products of combustion are carried off. The door for admitting fuel is quite air-tight; and the aperture, for admitting air to the ash-pit, is capable of being shut and opened according to the temperature of the air in the interior of the stove. The apparatus by which this is effected is as simple as it is ingenious: although the forms, in which it is to be found, are various, the principle in all is the same. A very simple one is selected, which will sufficiently indicate the principle, and mode of operation. In Fig. 12, *aa* is part of the stove, *bb* a pipe supplying the air to the ash-pit, *cc* a tube having its upper end in the interior of the stove, and its bent extremity on the outside; when the temperature in the interior exceeds the limit required, the mercury, which is in the tube *cc*, expands, and is forced up in the part *d*; thereby closing up the aperture of the pipe *bb*, according to the degree of expansion. The quantity of air admitted to the fuel is only sufficient to maintain combustion, so that the air passing off by the chimney is of small amount.

The partition, dividing the chamber into two, is the cause of a constant circulation being kept up, which soon causes the air in the interior to be somewhat uniformly heated. The effect which this partition thus has may be easily understood. The portion of air behind the partition, farthest from the fire, must of necessity be cooler than that in the front chamber; as there is no direct influence of the fuel in it, and the heat is withdrawn from the sides of the stove, forming its side and back. The air in the first chamber being heated, rises, and communicating with that in the second, is diffused therein, and deprived of its heat through the sides and back of the stove; being cooled, it descends, and, passing along the aperture at the bottom of the partition, is again heated by the fire, and ascends; so that there is a constant circulation of air maintained in the stove. The amount of air withdrawn by the tube *d*, Fig. 11, bears but a small proportion to that in the chamber.

It should be remembered that this stove is not adapted for maintaining ventilation: the circulation of air being of such trifling amount, that it will be necessary, in order to prevent the close and stifling atmosphere otherwise felt, to have proper arrangements made, by which the vitiated air may be withdrawn: this will, of course, necessitate the increase of heating power to make up for the heat thus withdrawn. From the slow combustion of the fuel, carbonic oxide of gas is generated; this has been tested, by placing a vessel containing a solution of subacetate of lead, in which insoluble carbonate of lead was produced. By increasing the rapidity of the combustion this effect may be obviated; but all such changes are departures from the original principle.

Stoves are sometimes fitted up with descending flues; the period of the introduction of this form is of early date. An artist of the name of Delesmus invented in Paris, in the year 1686, a stove of this kind, in which the smoke descended, and was consumed. JUSTEIN afterwards described it as follows, in the "Philosophical Transactions", (See *Journal des Sçavans*, 1686, page 116). In Fig. 13 "*abcd* is a hollow cylinder, made of plates of iron, open at both ends. within whose inferior base *bd* there is fitted the grate *bd*: this cylinder, which is the fire-place of the instrument, is joined to the cylindric tube *efg*, in such a manner that there is a free



communication between their cavities. This tube efg , is of the same capacity with $abcd$; made of the same metal, and, in the same manner, is open at g , and close at e . If then the tube efg be made very hot, and some live coals are laid on the grate bd , and over them some combustible matter, then the flame that is produced will descend into the tube ef , and pass through f g , and all the heat will go out at g ; and the smoke likewise that is generated following the same course, through the pipe efg will be forced to pass through the flame that fills the whole tube; and hence, being acted upon by the fire in all this passage, it will lose the thickness and disposition of smoke, will be converted into flame, and in this form, passing out of the aperture g , will disappear without any visible smoke or soot."

Dr. Benjamin Franklin was the first who improved upon this plan; and produced his vase stove, with descending flue. Fig. 14 is an elevation of this form. The top d of the stove is move-



Fig. 14.



Fig. 15.

able, and through this the fuel is admitted; it is provided with a hollow knob, perforated with holes, through which the air descends to the interior to support combustion; a grating is placed near the middle of the vase at c , and another at the bottom of the hollow base b ; the pedestal a is also hollow, and provided with a series of plates, forming a zig-zag passage leading to the flue. There is no communication between the flue and the room, excepting by the opening in the lid of the vase. The vase and hollow pedestal are placed in a niche in the ordinary fire-place, so that the heat produced is sent directly into the room. The plan, Fig. 15, will illustrate

the position of the passages in the hollow pedestal a ; b b is the pedestal; a a the grating at the bottom of the space b of the preceding figure; the smoke and flame, passing through this grating, goes towards the back of the chimney as at ce ; then, dividing into two streams, one goes round the partition marked d out to the chimney flue at h , while the other stream turns round f , out to the flue at h . The air, in passing, gives out its heat to the pedestal, and is thus communicated to the room. A box, or drawer, is inserted between the partitions c and e , below the grating a , into which the ashes drop.

This excellent contrivance would be much improved if the vase was lined with fire-brick; this would tend to prevent the air being desiccated by the overheating of the part in which the fuel is consumed.

One advantage obtained by this form of stove is, that the smoke from the coals being consumed, by passing through the burning fuel, the chimney flue will thus be kept comparatively clean; the only smoke passing through it being when the fuel is first kindled. By this consumption of the smoke the greatest advantage is taken of the fuel; the particles of soot, passing off in the generality of fires, being but portions of unconsumed fuel. The air in a common fire-place rising, as soon as it is heated, in great quantities uselessly up the chimney, much of the heating power of the fuel is lost; but in this stove, being made to pass downwards, and in contact with a large heating surface, the greater portion of the evolved heat is made useful. This form of stove may be used with advantage in heating an office, or basement apartment, where the floor is paved, for the following reasons:—the best mode of fixing it will be to dispense with the pedestal and enclosed partitions, and to allow the heated air, from the vase, to communicate with a horizontal flue, running beneath the pavement of the floor; this may be led in any direction required, and should finally communicate with an upright shaft, or chimney.

The horizontal flue may be made square, the paving stones forming the roof of it; or circular earthenware tubes may be adopted; these being placed in excavations rather larger than the diameter of the tubes. In the former case, the heat will be

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communicated to the room by the floor; in the latter, the air, surrounding the circular tubes being heated, must be admitted to the apartment above through grated apertures made in the floor. To have the full effect of this plan, the excavations in which the tubes are placed should be freely supplied with air.

A somewhat similar arrangement is mentioned by TOMLINSON as having been eminently successful; the heat obtained being kept up at an annual cost of 30s., while by another apparatus the cost was £18. (*Rud. Treat.*, page 108.)

It should be remembered that an essential requisite, in the construction of descending flue stoves, is a chimney with a good draught. With this adjunct, Franklin's stove will be found exceedingly economical. Another advantage, not generally known, to be obtained from its use, is the economization of the fuel; from its conservation, while in a red state, by the flame surrounding it. The conserving power of flame is familiarly illustrated by observing the wick of a candle when allowed to burn a considerable time; if completely surrounded by flame, the reddened portion will remain unchanged for a long time, but if moved from the influence of the flame, it is instantly consumed, and passes away. FRANKLIN, while noticing this among other advantages possessed by his stove, cites the above illustration of the principle (*Philosophical and Miscellaneous Papers*, page 74). His attention was first drawn to the circumstance, from having watched, through a small opening, in the side of one of his stoves, a piece of red coal, which he expected to see pass away consumed by the heat, remain for a long period without diminishing in bulk. As the flame to be kept up will require a continual supply of fuel, the conservation of the fuel is not carried out to its fullest extent, where flame is not continually passing downwards; nevertheless, Dr. Franklin found the stove very effectual in delaying the consumption of the fuel.

When descending stoves are adopted, care should be taken to instruct the parties attending them in the right way of kindling them. As an upward current is generally established in chimneys in the morning and evening, these will be easiest kindled before eight in the morning (CHIMNEYS), and after eight in the evening. In kindling descending flue stoves, the current must first be ascertained; if drawn steadily downwards, the stove may be lighted without danger of the smoke being drawn into the room; the coke, or coal, should be placed first on the grating, then sticks, and paper; the paper being lighted, it will ignite the sticks, and then the coals. By having a damper, or valve, placed at the top, where the air is introduced into the stove, the draught may be lessened, or increased, at pleasure.

Smoke, from all fire-places, stoves, and furnaces, having a considerable portion of heat contained in it, it becomes a matter of some importance to obtain contrivances by which this heat may be advantageously used. In the preceding remarks it has been shewn how the heat of the smoke can be made use of in common fire-places (see Fig. 6); and in some of the stoves which have been described, arrangements for this purpose are also indicated. Thus in the Franklin stove the smoke is made useful in giving out heat, and also when the horizontal flue is adopted. In describing the common stove, Fig. 9, it has been shewn that, by lengthening the smoke tube, the heat therefrom may be made available. This plan cannot, however, always be carried out; for, in the generality of cases, the length of tube will be cumbersome.

A mode of obtaining the fullest advantage of length of tube, with but little space, may be gathered from the following description: suppose the back of the stove to have a casing attached to it, the smoke tube finding access to it at one side near the top, and the casing to be provided with passages made with partitions, the openings of which will be at the top and bottom alternately, as in Fig. 6; these passages being covered with an external casing of thin iron, the smoke having to pass in a zig-zag direction, gives out its heat thereto. The casing should be easily removable, to clean the passages, when required, from the accumulated soot. The winding passages may be made of

circular earthenware tubes; if these be placed behind the stove, having perforations at top and bottom, the fresh air will ascend to the casing, pass in contact with the pipes, and issue heated into the room through the apertures above. This last arrangement will be more practically available when coke or charcoal is burnt in the stove, as the tubing will not be liable to be choked with soot: if the inside of the tubes be glazed, this will not happen so frequently, even when coal is used.

In hot-air pipe stoves, the gaseous products of combustion are led through a series of pipes to the chimney, the air to be heated passing in contact with the outer surface of the pipes; the form above described is therefore a stove of this description. The porcelain stove, another form of hot-air pipe stove, is highly recommended by REMP for producing "a mild, genial, and equal temperature" (*Illustrations of Ventilation*, p. 239). Fig. 16 is an internal elevation of this form; where *b* is the body of the stove, with the flue *c c c* circulating as shewn: the whole internal case and piping is covered with an external casing, provided



with apertures near the top and bottom, to allow the air to enter and pass out when heated.

The employment of Gas as a heating medium for stoves has long been suggested; but from the defective construction of the contrivances adopted, much prejudice was raised against their use, and their general introduction greatly retarded. As an economical heating power, attention has of late been so strongly directed to it, that it may be expected shortly to be seen largely employed in structures, both private and public. The gas stove originally introduced consisted of a gas jet, or series of gas jets, burning in the inside of a metal casing, the air to be heated passing in contact therewith.

The principal feature in these stoves was, that the products of combustion being considered so harmless, or at least unworthy of notice, when compared with smoke, no chimney was deemed necessary. Now herein lay the great objection to these; for independently of the deleterious nature of the fumes evolved, the offensive smell occasioned by the gas (which is peculiar to gas stoves alone) was enough to exclude them from general use. In many of the forms more recently introduced this erroneous plan of allowing the products of combustion to pass into the room to be heated is still followed out. It is conceived that so long as this is continued, so long will gas stoves be considered, and justly so, as unhealthy, and will be hindered from being used. If the products of combustion be taken away at once, the stove will then become as healthy as any in use; and if due care be taken that the surfaces, which the flame heats, are so small that it cannot create a temperature sufficient to burn the air, then it will be not only healthy, but the most economical form which can be used.

A good form of gas stove would be the arrangement of a circular pipe, punctured with small holes, in an internal casing; if this be covered with a second casing, leaving a space between the two, the air may be admitted between them, and passed into the room by apertures at the top of the stove. The products of combustion being of comparatively small volume, the tube to lead them away need not be of large diameter. A gas heating stove may be made with advantage on the principle of the "Arnott" stove. It is believed that this would be economical, and be productive of satisfactory results.

The true method, however, of having healthy heat from gas, is by placing a double cylindrical vessel containing water, round a series of gas jets; by which, the water being heated, will give out a grateful heat from its external casing. An idea of the economical nature of this mode of heating may be obtained from the fact, that forty-five gallons of water can be heated to a temperature of one hundred and six degrees Fahrenheit, from sixty-two degrees, in the space of six minutes; at an expense of one penny; calculating the gas to cost six shillings per one thousand cubic feet.

The result thus obtained is by the patent process recently

introduced by Mr. Defries. His plan is simple: a series of flat tubular pipes, communicate with the water in the vessel to be heated; copper pipes are placed along the whole length of these, perforated with holes, so that several hundreds of gas jets are thus made; the water flows into these tubes, and, being heated by the gas, ascends, and the cold water takes its place; this goes on till the whole water is heated. It is evident, that by a judicious placing of the gas jets, a large surface of pipe or tubing may be supplied with hot water, at a very moderate cost.

A very ingenious gas heating apparatus has recently been introduced by Mr. D. O. Edwards: it is termed the "Atmopyre". The following is the inventor's description of it:—"Hoods" of tobacco-pipe-clay are made, perforated with numerous holes, the fiftieth of an inch in diameter; below these, gas is introduced; mixing with the air, it forms a species of artificial fire-damp; this being ignited on the outside, burns with a pale blue flame, and soon raises the hoods to a red heat. A number of them are placed beneath an earthenware casing, the aggregate heat of the hoods raising this to a red heat. The hoods consume, when thus heated, five-sixths of a cubic foot per hour, and eight of them are calculated to warm a room containing four thousand cubic feet."

The fitness of the "atmopyre" to secure a perfect ventilation is thus exemplified by the inventor:—"A battery of twelve 'hoods' is inclosed in an earthenware case, which becoming heated to four or five hundred degrees Fahrenheit, constitutes a repository of heat. This is placed in an outer case of china, terra-cotta, common ware, or any other non-refracting substance. The products of combustion are carried away by a small pipe entering the chimney. The fresh air is brought from outside the house, through a large pipe, about six inches diameter, which communicates, by means of a valvular iron plate, with the space contained between the two cases. The air ascends in this area in large quantities, is warmed in its transient contact with the inner case, enters the room, through large holes in the top of the stove, at one hundred and twenty degrees of Fahrenheit, and diffuses itself equally through the apartment; maintaining such a temperature as the inmates may desire. The fire may be concentrated in one part of a room, or distributed over the several sides. The strictest economy would require that the 'chimney' or 'way out' for the products of combustion, should be in alto-relievo, within the apartment, in order that the least possible heat should be lost".

By a judicious arrangement of the outer casings, it is possible that a healthy heat may be obtained from this invention; which certainly recognizes the principle above advocated, namely, the carrying away of the products of combustion from the apartment. Without attention to this feature, no satisfaction will ever be obtained.

High temperature furnaces have now to be considered, or the forms of apparatus used for warming large spaces. Their leading feature may be stated to be, plates of metal, or surfaces of brick or stone, heated in or by a furnace or fire; the air to be warmed being caused to impinge upon, or pass between, them. It is evident that, from the nature of the process, the air cannot be regulated in temperature, and is liable to be over-heated; nevertheless, by great care, and an adaptation of the various parts of the machinery one to another, air may be effectively and healthily warmed.

This is exactly the principle which Mr. Strutt, of Derby, endeavoured to carry out; Fig. 17 is an elevation of the machine adopted by him. *a* is the internal fire-place; the smoke and gaseous products from the fire leave by the chimney, *c*; the internal casing, *b b*, is made of brick-work; an external case, *d d*, is placed over this, so as to leave a space, up

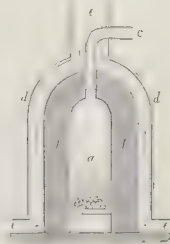
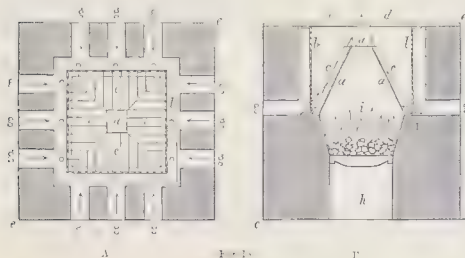


Fig. 17.

which the air can pass, as shown by the arrows, into the flue *e*. The fire heats the brick casing, which, in its turn, communicates the temperature to the air passing up the space. This is known as the "Strutt" or "Belper" stove (so called from the name of Mr. Strutt's seat in Derbyshire).

The principle of Sylvester's stove, is similar to that of Strutt's cokel; in fact, it is merely an improvement thereon. A cast-iron cone or cokel is placed above a fire-place or furnace; the air to be heated is projected through pipes made in an exterior casing, covering the cokel. In some cases this casing is made of brick-work: in the improved plans iron is used. The improved construction of this stove is shown in Fig. 18, where



A is a plan, and B a section, of the stove; *ee*, the fire-place; *i*, the fire; the chimney flue is at the back part of the furnace; *a*, the cokel; iron ribs, *ccc*, are placed in the manner shown in the drawing, so as literally to compel the air entering through the flues or fresh air openings, *gg*, to pass upon the heated surface of the cokel, it having been found that a flame held at the ribs was extinguished by the draught; the air thus heated passes upwards into the chamber *b* above, from whence it is led by flues through the plate *dd*, to the place to be warmed. This form of stove seems well adapted for economical heating; and by properly regulating the temperature of the heating surface, a healthy degree of warmth may be obtained.

There is one feature in connexion with it worth mentioning, viz., the facility with which cold air can be admitted to the building to which it is attached, in summer as well as winter. The change of temperature effected in a crowded or heated church, for instance, in summer time, is greater than would at first sight be supposed. At the Derby Infirmary, the cold air flue was four yards square, and seventy long. In the month of August, the temperature in the shade being 80°, the air which entered the stove room was 60°, and the velocity of the current was such as to blow out a candle.

In applying this stove in original constructions, a fire-proof chamber must be built expressly for it; this is, in fact, the cause which precludes its trial in buildings already constructed, and not similarly provided. There are, however, many churches, etc., having subterranean chambers, in which highly defective heating apparatuses are used, wherein the stove now under consideration might be placed with advantage.

The size of the fire chamber must obviously be so regulated, that the iron dome shall never exceed a certain temperature; 300° degrees was the limit assigned to it by Mr. Sylvester.

"In theory, Mr. Strutt's cokel is a simple and elegant application of principles to obtain the whole effect of the fuel; and in less skilful hands must have failed entirely, as far as regards economy; but in practice, it requires a building to be provided for it; otherwise it is a cumbrous mass, which it is difficult to find a place for, and still more so to give a tolerable appearance to the parts which ought to be ornamental as well as useful."—TREDGOLD, *Principles of Warming, etc.*, § 8.

Where a large quantity of air is to be heated, and consequently a large heating surface is required, the cokel will, from its size, be very awkward; if of very great diameter, as the fuel will be much spread in the interior, it will not be so

effective; consequently additional vertical height must be given to it.

In its place may be adopted the plan of constructing a longitudinal furnace, similar to that of a steam-engine fire-place, placing, round the brick case, a series of square flues, one side of which should be formed by the furnace casing: these flues should run along the whole length of the furnace, and communicate with a chamber, the opening of which should be at its highest part; at this, the flue leading to the place to be warmed should be attached.

In Fig. 19, *aa* is the front of the furnace, *b* the ash-pit, *c* the pipe leading to the apartment above. The entrances to the pipes are shown by the shaded squares.

A furnace might also be constructed with an arched top; a series of earthenware, or thick iron pipes, might run along within a few inches thereof, protected from the effects of the direct flame by a partly spherical shield, made of cast-iron, stretching below them. The fronts of the tubes are to be open for the admission of fresh air, the other ends to communicate with a chamber leading to the apartment to be warmed.

Another form of furnace for heating large quantities of air, known by the name of the Hot Air Pipe Furnace, is shown at



Fig. 19.

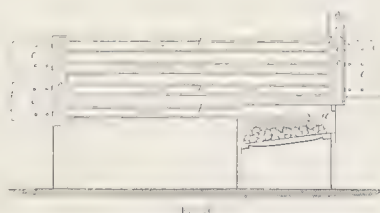


Fig 20; where *a* is the fire-place, with sloping bars; the heated air and smoke pass through the pipes *bb*, communicating with the chambers *ccc*, and finally issuing into the flue *g*. The pipes being thus heated, give out their heat to the air which passes up through, and between, the pipes, and is led to the apartment to be warmed by means of flues; or by grated apertures in the floor of the apartment, if the furnace room be situated directly beneath it: doors *ddd* are made to open into chambers *cc*, so that the interior of the pipes may be cleaned from their contained soot when required. In this form of stove the full effect of the fuel is obtained, the smoke being made useful.

In all these forms of apparatus, where a large separate chamber is required for them, the apartments above might be ventilated, by bringing the air, by means of channels, to supply the furnace. (VENTILATION.) In constructing the flue by which the air is led to the apartments to be heated, care should be taken to have the interior carefully covered with fire-proof cement; and, above all, not to allow beams to pass through, or indeed to come in contact with them. The circular stone-ware tubing might be used with advantage.

The common form of grating may be placed at the apertures for admitting the hot air to the interior of the apartment.

The interiors of the cokels and furnaces above described should be made of fire-brick, carefully cemented with fire-clay, or fire-proof cement; if more than one thickness be used, the joints of the last laid series should not coincide with those of the first, but should "break joint". This is necessary, as the heat opens the joints, even in the best made furnaces; and the gaseous products, escaping, become exceedingly noxious.

Common bricks should never be used for the interiors of furnaces, as they ordinarily emit, even at a low temperature, a disagreeable sulphureous vapour, causing a most offensive odour. The outer joints should be well pugged with blue stiff clay till

within half an inch of the surface, then finished with a layer of good consistent mortar; this treatment, if the furnaces be not very much overheated, will prevent the emission of noxious fumes.

In too many cases the heating surfaces of cokels are made of iron; this ought not to be done, as it is certain to create overheated air, and they are, moreover, inductive of danger. It is not too much to say, that almost all the public buildings consumed by fire owe their destruction to the defective apparatus employed to heat them. Parties fitting up such contrivances forget, or are not aware of the fact, that a *not very high* temperature is sufficient to ignite dry wood-work: and too frequently the parts are so defectively constructed that flame and smoke have egress into the flue. Wherever iron is used in hot air furnaces a lining of fire-brick should always be provided; the grand desideratum, in all such heating appliances, being to keep the temperature of such heating surface nearly to 212° , and never higher than 250° .

A process has been recently patented by Messrs. Davison and Symington in which the heated currents of air are used for drying purposes in various branches of manufactures; and which, under certain circumstances, is applicable to the heating of apartments, with a degree of precision and capability of control, seemingly highly advantageous. The principle may be seen



from the following diagram, Fig. 21. A series of bent pipes *c c c* are placed over a furnace fire *a*; the flame and heated air of which, coming in contact with the pipes, heats them to a high degree of temperature: the air to be heated is driven in and through these pipes by the fanner *d*. The velocity of these fans varies, according to circum-

stances, from nine hundred to thirteen hundred revolutions per minute; and any degree of heat can be kept up with the utmost regularity, by varying the velocity of the fanners, and consequently that of the air through the pipes. Any cessation of the action of the blower may be expected, however, to cause material injury to the pipes. The processes connected with architecture, to which this plan has been applied with the most signal success, are the drying of wood, and preservation of timber. (PRESERVATION OF TIMBER.)

As power is required in all cases to work the fanners, when a steam-engine is used in a building for ventilation, or other purposes, this form of heating apparatus may be used with advantage. Care in this case will be requisite to produce the requisite degree of heat; this is done by regulating the intensity of the fires, and the velocity of the fanners: the air, even when of a high temperature, being remarkably pleasant; this, of course, is to be attributed to the speed with which it passes over the heated surfaces. (VENTILATION.) Thus in a drying house for silk, when, by means of hot iron cokels, the temperature of the room was raised to 120° , the air was close, stifling, and oppressive: when the air was thrown in at the rate of seven thousand cubic feet per minute by the fanners, through small perforated iron plates in the floor, the sensation, on entering, was agreeable and pleasant; the temperature being the same. The great advantage obtained by the use of this process, is the speed with which the temperature of the apartment can be raised and lowered, by the properly regulated, yet constant, working of the fanners.

In all these contrivances, save in the last, a limited quantity of air only can be heated; as the surface would increase in proportion to the cubic contents of the place to be warmed: for a large space, a huge ungainly size would speedily be obtained; this would involve expense in construction, as well as in maintaining the fire. By stoves placed in the interior of a very large apartment, partial benefit only is obtained; the space near them being overheated, the places further off scarcely feeling

the influence. It is almost impossible to heat a church, for instance, equably by means of one stove, however large, placed in the interior, on a level with the floor.

The economical working of cokels, furnaces, and stoves, is of very great importance, not only as regards saving of expense, but the maintenance of a steady warmth: yet, unfortunately, little attention is paid to it. The plan generally adopted is that, a few hours before the building is to be occupied, the stove, or furnace, is lighted, and a huge fire is maintained with the view of "getting the heat up quickly"; the heat is frequently so intense as to crack the brick, or iron work, greatly endangering the building. The best mode is to keep up a gentle heat, for at least one full day before the building (if large) is required, and to maintain the fire at a low rate of combustion: the heating surfaces will then be gradually warmed, and the joints of the casing escape uninjured.

Another point too often neglected, is the supply of the flues with fresh air to be heated. In general it is considered quite enough if the fire-place is supplied; in too many cases this has not been attended to, and the flues may draw their supply of air as they best can. It should be remembered that the sole aim and end of all these contrivances is to heat the air; if this air be not supplied in sufficient quantities, it is clear that the heating power must be expended uselessly. Upon examining a heating furnace which was totally ineffective in warming the church to which it was attached, it was found placed in an apartment below the level of the floor; there was a fire calculated to raise easily as much steam as would have heated every part of an apartment three times the dimension of the church, in half an hour, or at the most an hour's time. This stove was generally kept up at this ruinous rate of expenditure for twelve or fourteen hours, sometimes in very cold weather for twenty-four hours; and, after all, the church was by no means comfortably heated when the congregation assembled. The mode of construction was as follows: above the arched top of the fire-place a large chamber was made, used to warm the air; the entrance to this, for admitting the air, was immediately above the door of the fire-place: from each side of the chamber a flue branched off, leading to a space made in the passage, and covered with a grating. The upward current was found scarcely strong enough to lift, very perceptibly, a silk handkerchief placed on the upper side of the grating; at the other, the handkerchief, instead of being raised, was pulled downwards; shewing the existence of a current down the flue instead of up, as it ought to have been. On descending to the heating chamber, the door of the hot air chamber was found shut; so that the air had to be drawn from one side of the church to be heated, and then passed into it at the other. The attendant had no very clear ideas as to the use of the door opening to the hot air chamber; all that he seemed to think necessary was the keeping up of a large fire. Now in this case, the type of too many others, had a full knowledge of the principles and constructive details of the apparatus been given, this result could never have existed. This has been pointed out as the cause of inefficiency in many arrangements, as well as explanatory of a simple means of experimenting on currents and movements of heated air.

The next method of heating large spaces by contact, is the use of steam as a means of giving heat to reservoirs, whose surface can never exceed the temperature of boiling water, unless the steam be created under a very high pressure; which is easily avoidable. If the surface of the metal, which it is employed to heat, be of a proper nature, the air is quite healthy; if iron pipes are used, no unhealthy exhalation is produced.

It is now upwards of one hundred years since the use of steam as a heating medium was first suggested. This was brought forward by Col. William Cook, in 1745: since which time, projects and contrivances, in amazing numbers, have been produced, all designed to carry out the principle.

The great advantages of steam over hot temperature stoves is the economy and facility with which it can be produced, and

conducted to any desired situation. The distance of the place to be heated from that where the steam is produced, has no influence in stopping the useful effect; care, however, being always taken that the pipes in which it is conducted shall be protected from cold, in order to avoid condensation.

In making arrangements for heating by steam, the points necessary to be considered are—the place and situation of the furnace and boiler, and the mode of distributing the pipe or heating surfaces; so as to heat the required quantity of air in the least possible space of time. The furnace should be so constructed, that the fullest advantage may be obtained from the fuel consumed. The first point to be aimed at, is to allow fresh air to have free access to all parts of the grating, or fire bars, on which the fuel is consumed. The freer this is, the more perfect will be the combustion, and consequently the effect derived from it. However, the combustion of fuel must never be pursued to that point at which the gaseous products, and the air necessary to blow the fire, consume more heat than the fuel generates.

The quality of the air to be admitted to the furnace is also of importance: the air ought to be dry and cool; if moist, it takes away heat; if cool, on entering the ash-pit, it passes with greater velocity through the fuel.

It may perhaps be objected to this recommendation, that it is opposed to the practice of having the ash-pits of furnaces supplied with water. In such cases, it must be remembered that the benefit derived from the practice is, that the draught of defective furnaces is increased by the steam which rises from the water, which, mixing with the smoke, renders it lighter. Experience of the working of furnaces shows, that the air supplied to the fuel should be cool, that it may pass with greater velocity through the burning fuel; and in this the opinion of TREDGOLD coincided:—"The quality of the air to supply the fire is another thing worthy of being considered, although any dirty wet hole is usually esteemed good enough for the fire-place. Now the air ought to be dry; for air charged with moisture is improper, and only takes away heat."—*Principles, etc.*, § 91.

The form of construction for the furnace will depend on the species of boiler used; a cylindrical or longitudinal boiler will evidently be differently circumstanced from a spherical one. As the principal point to be aimed at, is the economization of the fuel, there are certain important matters which ought to be considered in all constructions, whether for the one or the other kind. The object being to confine the heat, non-conductors ought to be used for the external brickwork, or walls, of the furnace, so as to avoid as much as possible the use of metal. The outside brick-work should be built with hard well-burnt bricks, and, if possible, have hollow walls surrounding the space in which the fuel is consumed. The space for the fire and boiler should be lined with fire bricks, set carefully in fire-proof cement. In the generality of furnaces, a flat piece of metal, called a dumb plate, is placed near the door; for which earthenware slabs or fire-tiles should be substituted. The best place for the boiler is where the flame can act at once upon the bottom; much heat is lost by placing the boiler too far in, as a cold current of air mixes with the flame and hot air every time the fire is stirred. At the place where the smoke leaves the furnace, a damper, made of cast-iron, should be hung, which, although usually made horizontal, should slide in a vertical frame, and be attached to a chain, which, passing over a pulley or pulleys, should have a weight at the extremity, to act as a counterpoise to the damper; by moving this weight up and down, the damper may be moved in a corresponding ratio, and the fire consequently regulated in intensity. The bars whereon the fuel is placed should not be larger than one inch in breadth at the top, and the distance, between each, not more than half-an-inch. To evaporate one cubic foot of water per hour, one square foot of aperture in the grating should be allowed for admission of air to the fuel. If fifteen square feet of surface of boiler are exposed to the flame for every cubic foot of water evaporated per hour, this allowance will be ample, and found consistent with general practice. Of this

quantity, one-third is reckoned as horizontal or effective heating surface, the remainder vertical. For the aperture of the chimney, SCOTT RUSSELL gives as a standard—one-fifth of the fire-grate, diminished at the chimney, to one tenth of the same area. "The chimney should be of the same diameter throughout its interior; and if of forty feet height, and one-tenth part of the area of the grate, it will give an abundant draught. If the height of the chimney be greater, then this area may be diminished, as the square root of the height is increased". The higher the flue, the greater is the upward current or draught; consequently, if the height is increased, the area may be proportionally diminished: this, as RUSSELL above shows, is as the square root of the height is increased. (*History of the Steam Engine*, chapter on Boilers.) The shape of the boiler generally recommended is the cylindrical, having spherical ends. If very small, it should be made of copper, this being the most economical material, as the thinner the metal the better, at the part where it is exposed to the flame. The outer surface, above the brick-work, should not be exposed to the air; if this be the case, it occasions a very considerable loss of heat: the best contrivance to obviate this, is to have an outer case surrounding the exposed portion, leaving an empty space of some three inches between them; this should be filled with a non-conducting material, as lime, animal charcoal, etc. A cheaper method would be lining the outside with bricks carefully cemented together. The quantity of water in the boiler is also a matter of some importance. A good proportion will be, ten cubic feet for every cubic foot of water evaporated per hour; and the size of boiler should be so proportioned that this quantity shall fill half of it; the other half having its capacity equal to, if not a little greater than, the capacity of the range of steam pipes to be filled for heating purposes. To ensure safety, and a proper attention to the quantity of water, etc. in the boiler, certain apparatuses should be used. The safety valve consists of a cylinder fixed to the top of the boiler, having free communication with the interior and the external atmosphere; on the lower part of this a valve is placed, having a vertical motion; the spindle or stalk of the valve is loaded with heavy weights at its upper extremity, or is pressed upon by a weighted lever. When the steam exerts a pressure on the under surface of this valve, greater than the amount of downward pressure, caused by the weight of the atmosphere and the load placed upon its upper extremity, the valve rises from its seat, and the steam is allowed to escape to the atmosphere, through the aperture provided in the cylinder. As nothing should be left to the final settlement of workmen, the professional master should himself see that every requisite condition is fully carried out. The following rule is given by TREDGOLD (*Principles, etc.*, § 103), to decide if the area of the safety valve be of sufficient size:—"It will be obvious that the safety valve should be of such diameter that the steam may escape as quickly as it can be generated by the fire under the boiler; for, with a less aperture, the steam will accumulate, and the pressure, tending to rend the boiler, will increase, even after it has become sufficient to raise the valve."

A sufficient pressure of steam for heating purposes is four pounds per square inch over and above that of the common atmospheric pressure: this should never be exceeded. It is almost unnecessary to state that this pressure is quite harmless: a pressure fourteen times as great is daily wrought with safety in many parts. If the quantity of water to be evaporated per hour is known, the rule for finding the area of valve is, according to the same authority:—"Divide the number of cubic feet of water that the boiler would evaporate in an hour by five, and the square root of the quotient is the least diameter that should be given to the safety valve."

After the safety valve, the next important appendage to the boiler is the feed apparatus. Fig. 22 is a representation of a simple form of feed-pipe: *aa* is part of the boiler; the level of water is seen by the horizontal lines; a tube, *bb*, is inserted in the boiler, passing down within a couple of inches of the bot-

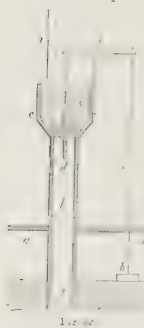
tom. At the top of the tube, a small cistern, *c c*, is placed, supplied with water from the pipe *i*. At the bottom of the cistern a conical valve is placed; this is furnished with a rod, *e*, attached to the end of the lever *f*, working on a standard affixed to the side of the cistern; at the other end of this lever a rod, *g*, is attached, passing downwards through a steam-tight aperture in the boiler's top, and fastened to the upper side of a stone float, *h*. When the valve is in its place, and the lever *f* horizontal, the bottom of the float *h* should rest on the surface of the water. And this line should be that of its proper level. When the water falls below this, the float descends, pulling with it the rod *g*, raising the opposite end of the lever, and, by means

of the attached rod *e*, raising the valve out of its seat; the water, flowing from the cistern, down the pipe *b*, to the interior of the boiler, rises in the interior, raises the float, and shuts the valve.

One thing should be attended to in this contrivance, namely, to make the height of cistern, from the boiler, sufficient to balance the pressure of steam in the boiler. It will be seen, that when the steam accumulates in the upper portion of the boiler, as it increases in pressure it will press upon the surface of the water, and force it up the feed-pipe, thereby opening the valve *d*, by pressing on its under side. On a rough calculation, a pressure of steam, fifteen pounds to the square inch, will sustain a column of water thirty feet high: so for every pound of pressure of steam, two feet of height should be allowed. It is better, however, to err in excess; so two feet and a half may be allowed. As before mentioned, four pounds of pressure should be the maximum, therefore ten feet will be required to be the height of the bottom of the cistern from the boiler. The cistern should not hold more than what is considered sufficient to keep up the necessary supply. When the pressure of the steam exceeds four pounds, it will force the water up correspondingly, and act in some measure as a safety valve. TREGGOLD recommends it, in small boilers, as a substitute for the safety valve; it is surely better to have the latter, and the feed-pipe will be a valuable auxiliary to it.

In order to ascertain with ease the relative quantity of water and steam in the boiler, the contrivance called the "gauge cocks" should be used. A tube is inserted in the boiler plate, at any convenient space near the top; this is continued to the water level, and a little below it; the external part of this tube must be provided with a stop-cock. When the water is at its proper level, on the cock being opened, the steam will force the water out of the aperture; if too little water be in it, steam will come from the pipe, and the feed apparatus must then be looked to. Another pipe is in like manner provided, but the tube only reaches to a little above the level of the water. When opened, if steam comes out of it, it is correct; if water, there is too much in the boiler.

Another contrivance (Fig. 23) used for this purpose, is known as the "glass water gauge". A glass tube, *b b*, communicates with the boiler *c c* at top and bottom, by means of the tubes *c c*, the apertures of which are closed by the cocks *a d*; the upper tube opens into the boiler where steam should be, and the lower where the water is. When the two cocks *a d* are opened, water enters below and steam above; and the pressure in the tube *b b* being equivalent to that in the boiler, the level of the water is equal in both; so that by a glance the quantity of water can be ascertained; the stop-cock *f* is used to withdraw the water which remains in the pipe. To ascertain the pressure of steam the "mercurial gauge" is used: a bulb, containing mercury, is attached to the part of the boiler containing steam, in such a



manner that when a cock is opened on the connecting pipe, the steam is admitted to the bulb, and presses upon the upper surface of the mercury; a glass tube, open at one end and closed at the other, is inserted at its open end into the mercury, its mouth nearly, but not altogether, resting on the bottom of the bulb; the pressure of steam in the bulb forces the mercury up the tube, in a ratio corresponding to the pressure in the boiler, and the air in the upper portion of the tube is compressed accordingly; if into half its original bulk, the pressure is doubled; and so on.

A man-hole door should be provided, and carefully covered steam-tight: when the boiler requires to be cleaned, this may be taken off, and entrance to the interior will be gained.

The distribution of pipes for conveying the steam is of great importance; as on this point, mainly, depends the efficiency of the heating apparatus; at least, in obtaining useful effect in the apartment to be heated. The remarks on this subject will also suffice for every form of hot water apparatus; the arrangements in this case being the same in both modes.

As to the materials for the pipes: that which has been universally and justly preferred, is cast-iron, from the great recommendations of cheapness, convenience of working, and ease of fitting up, combined with the absence of any peculiar or disagreeable scents. Copper should not be used in dwelling houses for heating, as a very peculiar odour is always emitted. Lead is sometimes employed for pipes to convey steam, but is wholly unfit for that purpose, because the heat of boiling water expands it beyond its power of restoring itself; and consequently, pipes of lead become larger every time they are heated, and ultimately fail. If it were not for this defect, it would be an exceedingly convenient and economical material for many parts of a steam apparatus. Tin pipes are often used; they are very cheap, but soon decay; when fitted up, valves should be provided, to admit the atmospheric air, if a vacuum happens to be formed in the interior; if this precaution be not adopted, a collapse of the tube will take place on such occasions. The brightened surface should be roughened and made black.

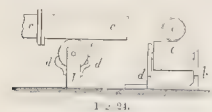
The effect of colour and surface of pipes, with reference to their power of giving off heat, has been much investigated. TREGGOLD gives the following account of the result of some experiments (*Principles, etc.*, § 115):—"A surface coated with lamp-black, appears to be the most effectual in giving heat (as determined by Professor Leslie's experiments), and a bright surface of tin the least; therefore, considering the effect of tin to be unity, or 1, it will serve as a standard of comparison. Now, according to experiment, it appears that a globular vessel of planished tin, four inches in diameter, filled with hot water, cooled down ten centigrade degrees in one hundred and fifty-six minutes. When the same vessel was painted on the external surface with lamp-black, it cooled the same number of degrees in eighty-one minutes: that is, the times of giving off the same quantity of heat are as 1:0.52, or nearly as 2 is to 1; or bright tin requires double the time to dissipate the same quantity of heat. But in another experiment, where the only difference was a greater excess of temperature in the hot water, the times were as 1 to 0.66. The times to produce the same effect with a bright surface of tin, and one of tin rubbed with quicksilver, so as to give it a splendid lustre, were as 1:0.96; but when sufficient quicksilver was added to render the surface a matted white, the times were as 1:0.89. When bright tin was coated with bibulous paper, soaked in olive oil, the times were as 1:0.55 nearly; but a thin film of oil did not reduce the time so much; the ratio in that case being as 1:0.83. Rubbing the surface of the tin with fine sand-paper shortened the time of cooling, and coarse sand-paper still more; in the latter case, the times were as 1:0.91. Different thicknesses of the same substance altered the rate of cooling; for the time for bright tin being 1, a coat of isinglass size, $\frac{1}{16}$ of an inch thick, reduced it to 0.7; a coat double that thickness reduced the time to 0.615; and a coat of ten times that thickness reduced it to 0.53. There is reason,

then to conclude, that mere colour is not of material importance, for it appears that a thick coat of isinglass size was as effectual as lamp-black. This remark is the more required, because in cases where the heating apparatus is to be ornamental, it will not be necessary to adhere to any particular colours, but to adopt those which harmonize best with the place". In fitting up pipes, rough blackened surfaces, as they are the most easily obtained, will be found to give considerable satisfaction; they may be blackened, and the rough surface attained by adding coarse emery powder.

The thickness of the metal of which the pipes are formed is a matter of some importance. In some cases, as in green-houses, the heat being required to be given out slowly, thick pipes will be best. In churches, dwelling houses, etc., the thinner they can be made, consistent with strength, the better.

The usual form for heating apparatus is the circular tube or pipe; this of three-eighths of an inch in thickness will be of ample strength. In addition to pipes, vases, pillars, etc., may be made to contain steam, and give off heat to the place in which they may be situated.

In fitting up pipes, due provision should be made for their expansion: if this be one-eighth of an inch for every ten feet of pipe, the allowance will be ample. To allow the range of pipes to have free motion while expanding, the best plan is to place them on rollers. The annexed Figure 24 will explain one mode, when the pipes are placed near the wall: *d* is the wall; *b* the bracket leaded into the wall, supporting the roller *e*, which is placed



at right angles to the direction of the pipe *a*. The pipe rests on the roller, and is allowed to move when expanding. The pipes should be placed near the floor of the building to be warmed, and as near as possible to the aperture made for the admission of fresh air.

The modes of joining the pipes are numerous: the simplest is the flange joint; a ring of vulcanized india-rubber, being screwed up tightly between them, will make a good steam-tight joint. The faucet joint is most frequently used; and when carefully rusted, it is perhaps the best that can be adopted, though not so simple as the flange joint. Fig. 25 shows the end, *a a*, of the pipe, passed into the socket, *c c*, of the pipe *b*. Iron cement is the best wherewith to make good these joints, proportions vary, but the following are usual: four ounces of sal-ammoniac to twenty-eight pounds of iron borings, free from rust and dirt. In using this cement, the ingredients are to be mixed together and moistened slightly with water; the composition thus made is to be forced between the joints with a caulking chisel and hammer: as much only as is required should be made at a time, as it spoils with keeping: if well made, it soon hardens, and expands equally with the iron pipes. Sulphur, often used in addition, produces disastrous effects on the iron and any painter's work. A new method of joining pipes, without any hemp or vulcanized india-rubber, has been recently introduced. The face of the flange is turned truly

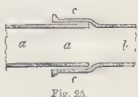


Fig. 25.

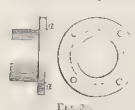


Fig. 26.

flat; a small groove, as shown by the dotted line, Fig. 26, is cut therein, and a piece of iron wire let into it at *a a*: a corresponding groove is let into the other flange. When the two are screwed together, the wire keeps the joint remarkably tight. This plan may be adopted with advantage, as it is a clean and efficient mode. In circular joinings, the best kind of joint is shown in Fig. 27. The ends of the pipe *b* are provided with socket joints, the pipes *c* being inserted with the cement. Joints may be made with flanges, as in Fig. 28. As, in circular junctions, the modes above shown of obviating the effects of expansion, are not available to their fullest extent, Count Rumford's expansion drum joint, Fig. 29, may be adopted. *b b* is a drum of thin copper, of sufficient

breadth to allow the requisite degree of expansion in the pipes, so as to allow them to draw out or compress the sides without injury; *c c* represent the pipes joined to the sides of the drum, in a state of tension.

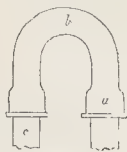


Fig. 27.



Fig. 28.

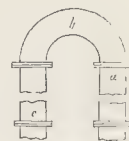


Fig. 29.

In some cases, flat or tabular pipes are used with advantage, in heating the air of an apartment; of course the steam supplied to them can be led by circular pipes. Fig. 30 is a good form of this species of heating surface; a series of flat receptacles, *b b*, are connected together by tubes, the upper one, *a*, supplying steam, the lower one, *c*, leading off the water of condensation; the fresh air passes at *d*, between the flat sides. Another mode of heating by these pipes is sometimes adopted, viz. —the conducting power of iron being so great, projections of this metal are added to the sides of the

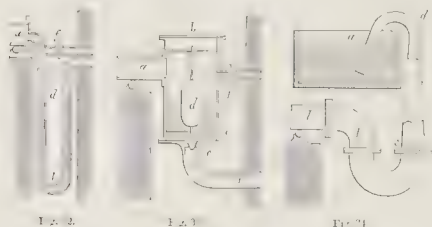


Fig. 30.

tubular surfaces; these derive a degree of heat from the steam therein contained, very little inferior to that of the flat casing. Fig. 31 shows this arrangement; where *a* is the supply pipe; the tubular surfaces have the projections *b b*; *c* is the condensed water tube.

In placing a range of steam pipes in any building, they should be laid with an inclination to the boiler; so that the condensed water shall be returned thereto. If the pipes be laid horizontally, the condensed water will remain in them; and when the apparatus is used after any cessation, the steam admitted to the pipes being condensed, by coming in contact with the cold water, a vacuum is suddenly formed, and, if the pipes are not strong, they are in danger of collapsing. In some cases, the water giving out its heat after the steam has been shut off from the pipes, it may be advisable to collect the condensed water at certain places, whereat stop-cocks must be attached, by which the water can be withdrawn. These cocks will also serve the important purpose of allowing the air in the pipes to escape, when the apparatus is first put in order. In cases where the water on condensation flows to the boiler, a small return-pipe may be attached to the lowest part of the steam-pipe, through which the water may flow to the boiler. This return-pipe should be made of malleable iron (not lead, for reasons before shown); and if it be required not to give out heat in the places through which it may pass, it should be covered with non-conducting materials. Steam heating pipes should at once proceed to the highest part of the building, and descend to the lowest; at the lowest place the return-pipe should be attached. A self-acting syphon, Fig. 32, by which the condensed water can be withdrawn from the apparatus, given by TREDGOLD (*Principles, etc.*, § 130), is most certain in its action. *a* is the lowest end of the steam heating pipe; to which a syphon, *d b c*, is connected; the waste of condensation runs off by *c* to the drain or other receptacle: this condensed water, being distilled, may be used for many purposes. In this arrangement, another pipe is provided with a stop-cock, *e*, by which the air in the pipes is blown out at starting. The place made for the reception of the syphon should be lined with materials non-absorbent of wet, and the pipe, when put carefully in its place, rammed round with animal charcoal or other non-conducting material, so that the condensed water may flow off hot, if so required. Care must be taken to prevent the length of pipe in *a b* being too short, as

in this case the water will be overbalanced by the pressure of the steam. Already, in describing the feeding apparatus, the mode of calculating the length of pipe containing water to resist a certain pressure of the steam, has been shown, with the result,



that for every pound of pressure on the square inch, two feet and a half of pipe must be allowed; in a case where six pounds is the working pressure, the length of syphon will require to be fifteen feet. As there will be considerable oscillation of the body of water in the syphon, a valve, opening towards *c*, may be placed at *b*. As, in many places, the necessary depth for the syphon pit may be difficult to be obtained, a contrivance, also given by TREDGOLD (*Principles, etc.*, § 131), may be adopted. (Fig. 33.) Let *c* in Fig. 33 be a square box attached to the lowest end of the steam-pipe; and *d* a hollow copper cylinder, fixed to a conical valve, *e*. When steam is condensed, the square box will fill with water, and float the copper cylinder *d*, lifting the valve *e*, through which water will flow, by the pipe *f*, to the drain; the valve *e* will be closed when the water is too low to float the cylinder. In this case, also, a stop-cock, *f*, is required, to let out the air on first starting. As in some cases it is impossible to have the boiler *beneath* the lowest place where the heat is required, the water of condensation may be forced up to a cistern *above* the level of the lowest part of the pipe, by means of the pressure of the steam. If the pressure is four pounds to the square inch, the height to which the water can be raised must be less than ten feet at most, nine feet to insure its working properly. Fig. 34 shows the plan; where *b b* is the heating pipe, *a* the cistern to supply the boiler, *d* the pipe up which the water is forced; a valve is placed at *c*, opening upwards, to prevent the water from flowing back to *b b*.

If the boiler be at a distance from the place to be heated, as in the case of forcing-houses, the main steam-pipe should be led in such a manner that little of the heat may be lost: this may be done by inclosing it in a box made of zinc or wood, charred on the outside, filled with animal charcoal or other non-conducting material, and placed in a trench or drain fitted with non-absorbent materials, as bricks, or earthenware tubes. Fig. 35 is a transverse section of the box: *a* is the pipe, *b* the box, *c c* the bricks on which it rests.

In distributing pipes in dwelling houses, if placed behind the skirting board, they will effectually warm the air passed into the room, and be at the same time concealed. In large saloons, the contained air cannot be warmed effectually by an ordinary open fire-place; but, as its cheerful appearance is much and justly esteemed in this country, it must be provided. Yet, at the same time, the heat from pipes should be combined with it. If the pipes, in such a case, cannot conveniently be placed behind the skirting board, they may be masked by some ornamental piece of furniture, as tables, etc. The pipes will be placed in masses, or a series of coils,—or, instead, the pipes may be placed beneath the flooring: the heated air escaping through apertures made in the floor. But wherever they are placed, it will be essentially necessary that fresh air should have free access to them, and to the room, on being heated to the corresponding degree required.

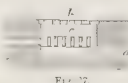
Much ignorance prevails as to the good effect to be obtained from a gradation of heat. A room having the temperature of 60°, is considered by a person sitting therein as by no means

warm; but by another, entering from a frosty atmosphere, the heat may be thought oppressive. If a person passed through a hall heated to a temperature varying from 45° to 55°, he would be accustomed to the heat of the room, and *vice versa*.

Pipes, as before described, may be arranged in decorative covers, or simply placed behind the skirting. If it could be arranged, the better way would be to have them near the centre of a hall. In the case of a central staircase, the air may be heated by placing a steam or hot water stove near the bottom. A simple and inexpensive form of heating apparatus is a cylinder of metal, shown in Fig. 36, having double



waterproof sides, covered with a decorative casing: the cold air rushes through apertures in the bottom of the casing, and some of it passing up the centre, *a*, and the remainder along the outside, *b b*, is heated, and escapes through apertures made at the upper side of the casing. In the arrangement of heating pipes in the interior of a church, public hall, or other large building, the utmost effect will be obtained by placing the congeries, of heating surfaces, beneath the perforated flooring (VENTILATION), a range of pipes running before all the apertures made for the admission of fresh air; this will cause the entering air to be heated at once. If the air be led to spaces in the passages, a flat perforated steam-box may be placed in the space beneath the grating, so that the air entering will pass over the heating surface. Fig. 37 is a sketch illustrative of this arrangement. *a* is the fresh air ventiduct: *b* the grating covering the space made in the passages; *c c* the flat perforated box connected with a steam boiler or hot water apparatus. This box will be easily made of zinc. The tubes passing through it in the direction of its thickness must be water-tight, at the place where they join the top and bottom plates of the box; the water of condensation is to be led away, by proper means. Instead of this box, a congeries of pipes, some inch and a half diameter, may be used. In some cases, the heating pipes may be led along the walls, at the places where the fresh air is admitted; but in the instance of a church, where pews are there situated, the parties sitting therein will feel the heat more decidedly than those in the body of the church. Pedestals, made hollow, may be placed with advantage in the entrances below the gallery staircases, and also at the space generally left before the pulpit. The following, Fig. 38, will give an idea of these arrangements. *a a* are the apertures made in the

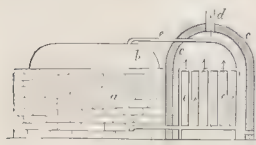


outside walls, for the admission of fresh air; *c c* the range of pipes running before these; *d d* the hollow pedestals, containing steam or hot water; *b b*, passages; if the heating surfaces be placed in each passage, the letters will denote their situations.



As it may be considered desirable to take down the defective apparatus, and fit up one better calculated to give healthy heat, in some extensive buildings already constructed, having a large chamber for heating made below the level of the floor, the following illustration is appended, of a very efficient form of apparatus, designed for a separate chamber; the heating medium being

steam; but hot water pipes may be substituted. In Fig. 39, *a* is the furnace; *b* the boiler; a chamber, *cc*, is made at the end of the boiler-furnace, of dimensions sufficient to contain the requisite area of pipe; this chamber should have a domed roof, in the centre of which the pipe *d*,



for leading the heated air to the interior of the church, etc. should be placed. A range of vertical pipes, *ee*, are placed within this chamber; and the air admitted, to pass along them by apertures made in the brick-work, near the ground. The air thus led to it should be brought by pipes or wooden boxes direct from the open air. When the steam is admitted from the boiler to the pipes, the air passing upwards is heated, and escapes by the aperture *d*. A small pipe should be connected with the lowest part of the congeries, so as to afford facility for drawing off the condensed water. The whole of the pipes should be connected with one another. If this be well made it will give great satisfaction, in cases where it is thought desirable to send heated air into the building, without the intervention of pipes, pedestals, etc.

The first step in the investigation of the requisite area of pipe for any desired building, will be the quantity of cubic feet of air required per minute. In order to ascertain this, attention must be given to the loss of heat by ventilation, and the direct influence of cold external walls, glass windows, etc. From the first cause there will be a loss of heat proportioned to the quantity of air withdrawn per minute: if four cubic feet are supplied to each individual per minute, then "there will be for each individual four cubic feet of air per minute, conveying off a quantity of heat equal to the difference between the heat of the external air and that of the room." Thus, if the heat of the room be 70°, and that of the external air 50°, then it is clear that the withdrawal of four cubic feet of air per minute must lead off a quantity of heat equal to the difference between 70° and 50°, or 20°. In other words, the ventilation causes a certain loss of heat, which, in a close room, with the air stagnant, would not be the case. From the second cause there will also be a loss, as heat is transmitted very quickly through glass: the quantity of air cooled in a given time being simply proportional to the surface of the glass exposed to the external air; and, consequently, will be constant, whatever variation of temperature may take place. The rule given by TREDGOLD (*Principles*, etc., § 67) for finding the quantity of air that will be cooled, per minute, from the temperature of the room to that of the external air, is as follows: "If the area of the surface of glass be multiplied by 1.5, the product will be the number of cubic feet of air per minute which will be cooled from the temperature of the room to that of the external air"; and to this loss will also be added that arising from each door and window (independent of occasionally opening and shutting the former): this was calculated, by the same author (§ 65), to be equivalent to eleven cubic feet per minute, the difference of temperature between the internal and external atmosphere being 60°.

From a combination of these circumstances, assisted by various experiments, TREDGOLD (§ 68) deduced the following rule: if the number of people the room is intended to contain be multiplied by four (or according to the quantity of air allowed per minute), and added to eleven times the number of exterior windows and doors (as eleven cubic feet of air is passed through each per minute on an average), added to one and a half times the area in feet of the glass exposed to the external air, the sum obtained will be the quantity, in cubic feet, to be warmed per minute.

The next operation is to find the surface of pipe which will heat this quantity of air. The mean temperature of steam-pipe, at the ordinary pressure, is 200°. To make this calculation, the temperature of the external air, or of the air that supplies

the ventilation, is to be known at the extreme case of cold, which, for the day, may be taken at 30°, but, for night, may generally be assumed to be at zero of Fahrenheit's thermometer, as the cold is seldom more intense in this climate. The temperature at which it is proposed to maintain the room, or place to be heated, at the same season of cold, is also to be settled; and (fixing the mean temperature of steam-pipe, at the ordinary pressure, at 200°) TREDGOLD (§ 44) also gives the following rule: multiply the cubic feet, per minute, of air to be heated, to supply the ventilation and loss of heat, by the difference between the temperature the room is to be kept at, and that of the external air, in degrees of Fahrenheit's thermometer; and divide the product by 2.1 times the difference between 200 and the temperature of the room. This quotient will give the quantity of surface of cast-iron steam-pipe that will be sufficient to maintain the room at the required temperature.

The examples by the same author may be condensed. A staircase, hall, and two passages are to be maintained at 56°, when the external temperature is at zero. There are two windows, each 10 by 4 feet, in the hall; a skylight in the staircase, the superficies of which is 100 feet; two windows in each of the passages, each 7 feet by 3 feet 6 inches; in all 278 superficial feet of glass: this multiplied by 1.5=417 cubic feet cooled per minute. The loss from ventilation, by the skylight, placed 30 feet from the floor (TREDGOLD, *Principles*, etc., § 136), and the other openings, will be 275 cubic feet per minute, 417 × 275=692 cubic feet per minute to be warmed. By the rule, the quantity of heating surface will thus be found: $\frac{692 \times 56}{2.1 \times (200-56)} = 128$ feet of surface of steam-pipe. In a room containing 1,200 people, containing 100,000 feet of space, the number assembled being, in winter time, on an average, 600, where the surface from 28 windows is equal to 1,000 square feet, and the heat to be maintained, 60°, the external air being 30°, the loss from the glass surface will be 1,500 cubic feet, from ventilation 2,400, and from windows, doors, etc., about 300—in all, 4,200 cubic feet: then by the rule, $\frac{4200 \times 30}{2.1 \times (200-30)} = 428$ feet of surface required. According to Dr. Arnott, one foot of superficies of heating surface is required for every six square feet of glass; the same for every 120 feet of wall, roof, and ceiling; and an equivalent quantity for every six cubic feet of air withdrawn from the apartment by ventilation per minute (TOMLINSON, *Rud. Treat.*, p. 124).

TREDGOLD'S Table of the quantity of Steam that will fill a given Length of Pipe, and of the Length of Pipe for one foot of the Surface.

| Interior Diameter of Pipe. | Length of Pipe that will contain one cubic foot of Steam. | Quantity of Steam in one foot in Length of Pipe. | Length of Pipe that has one foot of exterior surface. |
|----------------------------|---|--|---|
| Inches. | Feet. | Feet. | Feet. |
| 1 | 183 | .00515 | 3.28 |
| 1½ | 81 | .01225 | 2.18 |
| 2 | 46 | .02182 | 1.63 |
| 2½ | 29.2 | .034 | 1.31 |
| 3 | 20.3 | .049 | 1.09 |
| 4 | 11.5 | .0873 | 0.82 |
| 5 | 7.3 | .1303 | 0.66 |
| 6 | 5.1 | .1964 | 0.55 |
| 7 | 3.7 | .267 | 0.47 |
| 8 | 2.9 | .349 | 0.41 |
| 9 | 2.25 | .442 | 0.36 |
| 10 | 1.83 | .545 | 0.33 |

In order to obtain the full effect of a steam heating apparatus, economically, great attention must be paid to the firing of the furnace. The best mode is to fill the space at the front of the fire with fresh fuel, with the damper pulled only a little way up, so that the draught may not be too strong. The fuel will be gradually heated, ready to enter into combustion, when pushed forward by the stoker; and a new supply of fuel should then be added, in the place of that which has been thrust forward into the fire. The gases which distil, from the fuel having to pass over the red-hot embers, which are to be supplied with air from the ash-pit, will generally be wholly consumed in passing the throat of the chimney. In raising the steam, the quickest mode of

firing is to supply fuel frequently, but in small quantities, spreading it as thinly as possible over the grating.

Where power is used in a building, for ventilating or other purposes, in connexion with a steam heating apparatus, self-acting machinery may be used with advantage for feeding the fire.

The revolving grate (the patent of which has expired), will give satisfaction. Its principle of action of contrivance is as follows:—the grating is made circular, and is capable of revolving: the coals are showered down upon this grate as it passes a slit made in the boiler, near the furnace mouth. The smoke evolved from the fresh coal is consumed by passing over the clear burning portion, which has formerly had its smoke consumed during the revolution of the grate. Jucke's Patent Furnace is highly spoken of as a self-feeding arrangement; with bars, in the form of an endless chain; the coal being carried forward gradually as it is burned; as the chain turns round the furthest carrying roller, the ashes and clinkers are precipitated into the ash-pit.

When pipes exceed six inches, in order to give the requisite degree of surface, two or three smaller pipes would be better; and in order that they may give out heat, even after the steam has fallen down, TREDGOLD (§ 17) recommends pebbles, etc. to be placed in their interior. This arrangement will certainly, at the first starting of the apparatus, cause a large portion of the steam to be condensed, by coming in contact with the cold pebbles; but this loss is only apparent, as the heat thus taken up will afterwards be given out: but disadvantages will immediately occur to the reader.

The last division of this subject now remains for consideration: viz.,—raising the temperature of air by passing it in contact with the external surfaces of pipes or receptacles containing hot water.

In consequence of the greater simplicity of action, and the ease with which it is maintained in operation, hot water apparatus possesses many advantages over that of steam; in which, from the multiplicity of appliances necessary to keep it in operation, and to ensure its safety, derangement of the parts sometimes ensues; and the consequences, if not dangerous to those who may be near it, are, at all events, destructive to the apparatus, in a greater or less degree, according to the nature of the accident. On the contrary, no danger need be apprehended from the use of hot water apparatus; even in the high pressure form, the risk of explosion, as hereafter shown, is very slight. Another advantage which hot water possesses over steam is, that after the water is once heated, so long as it retains its heat, even if it be only one or two degrees above the temperature of the surrounding air, the circulation is maintained in the pipes, and heat is communicated to the air: the water can thus give out heat long after the fire is extinguished. With steam, the moment the fire is extinguished, the heating effect of the pipes begins to be lost; for as soon as the temperature falls beneath the boiling point, the steam is condensed; and although the pipes may (and do in some instances) for a considerable time give out some heat, this effect is speedily suspended. Again, a small fire, maintained in a state of slow combustion, keeps up a sufficient circulation, in the hot water pipes, to give out a considerable heat; while to keep "steam up", as it is termed, close and careful attention is requisite, to have the fire in a state of vivid combustion.

The plan of heating by hot water affords a beautiful instance of the application of principles, as indicated by science, to the useful purposes of every-day life. Its introduction dates from an early period; about the year 1716. Sir Martin Treewald, of Newcastle-on-Tyne, heated a hot-house by the circulation of hot water in pipes, the boiler being placed outside. It was, however, in France that it was successfully adopted on a large scale. In the year 1717, M. Bonnemain introduced an apparatus for the hatching of chickens, in which the heat was maintained by a congeries of pipes containing hot water. In 1816, the Marquis de Chabannes re-introduced the system into England, and strenuously advocated its adoption. But it was not until Mr. Atkinson took it in hand, and by his practical modifications freed it from many difficulties, that the invention was largely used.

The circulation of hot water particles in pipes is caused by the unequal density of the fluid, arising from the difference of temperature in the ascending and descending columns of water connected with the heating reservoir; and its velocity is governed by the height of the columns (BRAMAN, *Appendix to Tredgold*).

If heat be applied at *a*, Fig. 40, at the bottom of a tube, *b*, filled with water, the currents will be in two directions; the particles ascending being warm, and those descending being cold. The circulation is thus kept up by what is termed the process of "convection". Heat is communicated to solid bodies by the process of conduction. In the heating of water the process is different: water is one of the worst conductors of heat; a vessel full of it may be boiled at top, by applying heat thereto, without raising in any material degree the temperature of the mass beneath; the water below, if warmed at all, being raised in temperature almost solely by the conducting power of the material of the vessel in which it is contained. The particles of water being possessed of extreme mobility, move amongst one another with the slightest force. When heat is applied to the bottom of a vessel containing it, the whole mass becomes warmed in the following manner. The particles next the fire becoming heated, expand, ascend, and distribute their heat to other particles surrounding them, until their temperature is equal to the particles they reach; the cold particles, descending and coming in contact with the heated surface at the bottom, are heated, expand, and rise, in their turn; this process goes on till the water is all equally heated; when, under certain circumstances, it passes off under the form of vapour or steam. The vessel containing the water, however large, as in the case of ranges of pipes, communicates its heat to the surrounding air by conduction; the temperature is thus decreased, and a descending motion is the consequence. In fact, in every properly constructed hot-water apparatus, as the pipes are continually throwing off their heat, so perfect quiescence of the contained fluid may be said never to occur, the particles being in continual motion.

As illustrative of the arrangements of a hot-water apparatus reference may be made to Figs. 42 and 43 below; where *a* is the boiler, *b b* the ascending pipe leading to the supply cistern *d*, the descending pipe *c c*, which gives out its heat when required, communicating with the lower part of the boiler *a*; so long as the heat in the boiler is maintained, so long is there an ascending and a descending current. If the pipe *b b* be not intended to give off heat, it should be wrapped round with non-conducting materials; by keeping this mode of confining the heat in view, any part of a pipe may be prevented from throwing out its heat.

The force of the motive power, with which the water returns to the boiler, depends upon the difference between the specific gravities of the ascending and descending columns; when the difference is slight, the motive power is reduced to a small degree; practically it is in all cases sufficient to maintain the circulation. The motive power being in all cases, however, of very slight force, all obstruction in the pipes, as well as sudden turns, or right angles, should be carefully guarded against; a very slight obstruction is sufficient to stop, at least to materially alter the effect of the current. Before being fitted up, therefore, the interior of the pipes should be carefully inspected, and cleaned out. A considerable loss of motive power is sustained through friction; the pipes should therefore be cast as smooth as possible, and the joints perfectly straight, and close up to one another.

The higher the column of hot-water pipe is, the more force will the water have in circulating. In cases where this altitude is unattainable, the same result can be obtained by having the difference of temperature, between the ascending and descending columns, increased; an effect equal to the heightening of the columns is in exact proportion to this difference; if the temperature be doubled, the result is equivalent to doubling the height. The mode of attaining this difference of temperature is by

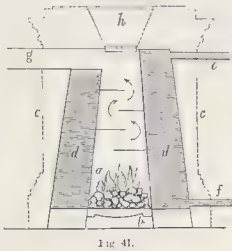


FIG. 40.

increasing the surface of the heating pipes in the descending column; so that in a less space of time more heat is thrown off.

With the same quantity of water, a larger surface may be obtained, by adopting the flat tubular pipes shown in Figs. 32 and 33.

Fig. 41 is a diagram, illustrative of a heating stove, or boiler, which not only warms the place in which it is situated, but keeps up a supply of water to ranges of pipes or pedestals in other apartments. A cylindrical vessel, *d d*, is provided with an interior furnace, *a*, having a chimney, *g*, to carry off the products of combustion, the fuel being introduced by the lid *h* at the top; an external decorated covering is placed as at *c c*, with holes perforated at top and bottom; and the fresh air, entering at the bottom, passes up the space formed between the interior of the decorated casing and the exterior of the internal boiler, is heated by coming in contact with the latter, and escapes at the top of the casing into the room. The pipe *e* will carry the hot water to another room, where it may be attached to a vase, pedestal, or range of pipes. The cooled water pipe, *f*, communicates with the under part of the boiler.



In such a low temperature hot water apparatus, the three requisites are—the boiler, or heating furnace, the cistern, and the heating pipes.

In Fig. 42, *a* is the boiler; *b b* the ascending pipe, through any number of floors; *d* the supply cistern, or expansion box; *e* the pipe for the escape of the vapour to the atmosphere; *f* the water supply pipe; and *c* the descending pipe; and *g* the thermometer.

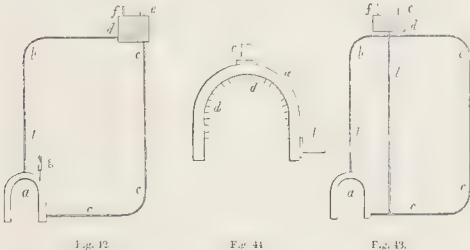


Fig. 43 is another form of apparatus; where *d* is a pipe leading from a cistern to supply the boiler. In Fig. 44, *a* is the boiler, *b* the return pipe, *c* the ascending pipe; the inside of the boiler is sometimes provided with projecting ribs of iron, *d d*. The conducting power of the metal being great, the flame and heated air, which might otherwise be comparatively lost, are advantageously used; the surface receiving heat being increased.

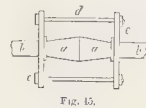
While treating of steam heating, it was shown that for every fifteen feet of boiler surface exposed to the fire, there will be one cubic foot of water evaporated per hour: from this is deduced the rough calculation, that for every fifty feet of four-inch pipe, one square foot of boiler surface is required.

The higher the cistern is above the boiler, the greater is the pressure in the lower portions of the pipes; hence the difficulty of keeping joints tight where the pressure is great; yet the cistern or box wherein the water expands must be higher than the level of the highest place to be heated. The expansion box should be covered in, and have a pipe communicating with the external atmosphere, to allow the vapour or steam produced by overheating to escape. A pipe leading from a cold water cistern should supply the expansion box with water, to make up for the loss by evaporation and leakage. If the box or cistern be not designed to give out heat, it should be covered on the outside with non-conducting

material. A thermometer may be inserted, to ascertain the temperature of the water, at any part of the tubes required.

The ascending pipe should proceed from the highest part of the boiler, and be finished at the lowest part of the cistern, supply, or expansion box. The descending pipe should leave the lowest part of the cistern, and communicate with the lower portion of the boiler. Care should be taken to have the pipes and boiler of sufficient strength to resist the pressure to which they will be subjected: this increases with the height. On a rough calculation, the pressure exerted on any body subjected to that of a column of water, is one pound on each square inch for every two feet in height; or, as some calculate, thirty-four feet in height gives fifteen pounds pressure to the square inch. The principle on which a barrel full of water is made to burst, by screwing a long tube to its upper end, and filling this tube with water, results from the fact that the pressure is as the height or depth, and not influenced in any degree by the size, shape, or extent of sectional surface of the pipes or vessels.

In joining pipes, the socket or faucet joint is decidedly the best, well caulked and rammed tightly up with iron cement.



Mr. Perkins's method of joining pipes of cast-iron is highly ingenious. At the end of each pipe, *b b*, Fig. 45, to be joined, conical portions, *a a*, are attached; their edges, being truly turned, are pressed closely against each other by the screws, *d d*, passing through the flanges, *e e*.

In heating large spaces, there has been much discussion relative to the best form of heating surfaces to be used. Round pipes of large diameter were first introduced; they are, however, clumsy, and when filled with water, very heavy; moreover, when used in private houses, the walls, etc. are often much cut up, to admit pipes of so large a bore. It is, indeed, a very difficult matter to get the requisite quantity of heating surface from these pipes without spoiling the appearance of the apartment in which they may be placed. The only point in their favour is their containing so great a quantity of water; they are in fact reservoirs of heat long after the fire is extinguished.

The next improvement in heating surfaces was the adoption of square pipes or tubular vessels (Figs. 30 and 31). When first introduced they were made of cast-iron plates, bolted together by projecting flanges. This clumsy plan was soon discarded, and they are now very neatly made by welding the plates together. The distance between the plates is generally one inch; and the series of receptacles one inch and a half apart. Compared with circular pipes, the quantity of heating surface obtained is about as three to two. This constitutes the value of this form of heating surface. As these plates give off heat very rapidly as compared with pipes, a proportional increase of fuel consumed in the furnace is necessary. This apparent disadvantage is, however, counterbalanced by the comparatively short time the apparatus is required to be in action, and by the small weight of water contained in the receptacles, in proportion to their surface. One objection to the flat receptacles is, that when under a high pressure, the welded joints are apt to give way; the force on an extended surface being very great. In fitting them up, it is evident that any degree of decoration may be given to them; even strips of cast-iron ornament, or moldings at the top and bottom, will constitute, being metallic, effective heating surfaces.

In arranging the position of the pipes, the points to be considered are—their distribution so that each apartment shall be effectively heated to the temperature required; and their levels so adjusted that no air may accumulate in any part, and impede the circulation. With reference to the first point, it will be seen that when the hot water is taken up at once to the supply cistern, the descending pipes nearest the cistern will give out more heat than those placed in the lower apartments, near the boiler; the water, by the time it reaches there, being deprived of a considerable portion of its caloric. The simplest method of effecting the desideratum, in this case, is to have the hot water

taken directly to the cistern; and led from this, by separate ranges of pipes, to the various apartments to be warmed; taking care to cover the pipes until they reach the place in which they are to give out heat. The circulation may be stopped in each range, by having cocks attached at convenient places. The apertures in the cistern leading to the various ranges may be made conical, with corresponding plugs, fastened to the sides of the cistern by chains. The various ranges should be numbered, and the plug apertures correspondingly marked; so that the desired range could be shut off at once, by inserting the plug belonging to it. To prevent the accumulation of air in the pipes, air-cocks and pipes should be attached at the places where the pipes change their level. However small the descent may be, this should be carefully attended to, as a very slight alteration has often been found to render the accumulation of air so decided, as nearly to destroy the usefulness of an apparatus, though in every other respect fitted up with the utmost care. If the air-vent were to be made at part of a pipe at *a*, Fig. 46, the accumulated air would be withdrawn from *a b*, but none would be taken from the portion between *c e d*, as it would have to descend through the pipe *d b*, filled with water, which, as air is lighter, is an impossibility. It is clear, then, that the difference of level, even of a short distance, should be attended to; half an inch militating against the working of an apparatus, as much as half a foot. If the circulation in a low temperature apparatus be stopped, and there be any certainty that the pipes were carefully cleaned out, and freed from all internal obstructions when fitted up, then the levels should be examined; and at every change, air tubes should be attached; if the air tubes be carried to a level higher than that of the supply cistern, they will be self-acting, requiring no stop-cocks. The water with which to supply boilers is of some importance; that which is free from all carbonaceous deposit being best. If the apparatus be not used for a certain portion of the winter months, the water had better be taken out of the pipes, lest the water freezing in them should burst them.

In the species of hot water apparatus here described, the heat of boiling water cannot be exceeded, the pipes being open to the atmosphere; it is consequently called the "low temperature" apparatus. The "high temperature" apparatus, as introduced by Mr. Perkins, a highly philosophical system, carried out by constructive details of great ingenuity, remains to be noticed.

It may be simply described as the process of placing water in a coil of pipes, of small diameter, closed so as to prevent all communication with the external atmosphere; and thereafter of applying heat to the lower portion of the coil, by which the temperature of the contained water can be raised to a very high degree. By this apparatus, a heat of 300° or 400° can be so easily obtained, (although there is no reason why the temperature may not be maintained at a much lower heat,) that here lies one objection to the plan: the high temperature thus raised is as influential, in burning the air coming in contact with the pipes, as the highly heated surfaces of high temperature stoves. This objection is very valid, and, in the opinion of many, militates much against the general introduction of the plan. The only way of obviating the difficulty, is by covering the coil of pipes with external plates, by which any required degree of reduced temperature may be obtained.

As the expansive force of water, when heated, is very great, due care is taken, in fitting up the pipes, to allow space for free expansion. This is obtained by having, at the highest portion of the pipes, a length of tube, two and a half inches or three inches in diameter, in which the water is allowed to expand. The proportion which this tube should bear to the small pipe, varies in practice from ten to twelve feet per cent.; one-tenth of the space of piping may thus be allowed for expansion.

In this form of apparatus, the great novelty in the adaptation of the heating power is the absence of a boiler; which is no less elegantly than effectively supplied, by having a coil of the small

tubing, placed in such a way that the surface of at least one-sixth of the whole piping is subjected to the heat of a furnace, in which the coil is placed. The forms in which this is done are various. The tube from the furnace is led direct to the expansion tube, which is placed at the highest part of the building where the heat is required; and from this any number of columns may be led to the various apartments to be warmed; uniting, and entering the coil at the furnace. There is no necessity for having the furnace in the same building with the heating coils; it may be completely outside, care being taken to cover, with non-conducting material, the pipes, when not required to give out heat.

Fig. 47 will explain the arrangement of a hot-water high temperature apparatus for warming a range of apartments, A and B; *a* is the boiler, or coil of pipes in the furnace; *e e* the descending pipe, coiled in a mass, in the inside of the ornamental casing *d d*, placed on the floor of the rooms; the tube entering the bottom of the coil *a*. Wherever the coils are placed to give out heat, to insure a speedy current, a good supply of air should be provided. In placing the pipes behind skirting, care should be taken to protect woodwork, as it is a perfect possibility that the heated air may rise to such a temperature as to cause combustion. A very little addition to the temperature of many hot-water apparatuses, would easily ignite combustible materials. For remarks on this subject see "THE BUILDER" for June 20, 1850. To prevent the temperature in any case from exceeding 325°, a heat sufficient for all purposes, the expansion tube *c* has been provided with a safety-valve, loaded with a pressure of ninety-one pounds to the square inch, which would on opening allow the water to escape, and flow into a receptacle provided for it. It will be seen that



Fig. 47.

this is a bad practice, because the loaded valve subjects the apparatus to a constant pressure which in working it does not always have; and because, when the expansion exceeds the pressure of the valve, the water is driven out, the coil is destroyed, red hot vapour is formed, and danger arises: the true remedy is the proper proportioning of the coil or boiler to the radiating surface. By exposing malleable iron to long continued high temperature, it loses its fibrous nature, and becoming crystalline, its cohesive force is much lessened; hence the advantage to be derived from preventing a great overheating of the pipes. Although, with good workmanship, there is no difficulty in making tight joints for a low pressure (up to 50 lbs. on the square inch) apparatus, yet before the introduction of Mr. Perkins's plan, the leakage of pipes, large or small, was a constant source of annoyance: the desideratum, then, was a joint which would be rendered tighter by the expansion of the pipes. This Mr. Perkins has succeeded in effecting, in a peculiarly satisfactory manner. If the ends of the tubes, being applied to each other, are both screwed with a right-handed thread, as the common gas-pipes, the turning of a socket, tapped to match, round the two ends, draws only one in, and pushes the other out. But if the ends be screwed, the one with a right, the other with a left-handed screw, the turning of a socket (tapped to match) will draw the ends together. The tubes, then, being thus screwed, and made three sixteenths of an inch thick, one end is turned in a lathe perfectly flat, which affords a good bearing for the end of the other pipe, which is brought by the lathe to a sharp edge; the socket being then forcibly turned by a pair of long handled tongs, drives the two ends together, till the sharp end is firmly imbedded in the flat one. With such a joint, it is clear that the more the pipes expand, the more forcibly will the joint be tightened; and the pipe will fill the socket, fitting more tightly the more the screwed part of the pipe expands. The superiority of this method of making joints over any that could be applied to the large round or flat tubes, is the highest recommendation that Perkins's method could possibly possess over the other; since in

that method alone can perfect security be found. When we consider the annoyance of an escape of water, the damage a handsome building may sustain by it, and the expense incurred in repairing such defects, its preeminent advantages must be strikingly obvious. And if we suppose the possibility of an escape from the small tubes, it is trifling compared with that from the other kinds, the least capacious of which requires eight times the quantity of water, nearly the whole of which may leak out. (*On the Comparative Merits of the various Systems of Warming Buildings by means of Hot Water.* Dublin: 1837. pp. 11-13.) But the experience of many years has fully proved, that if this species of joint is left sound, no leakage takes place afterwards; it will last as long, in fact, as the pipes to which it is attached: *in the furnace portion this duration is not always calculable.*

After the pipes are fitted up, and previous to the fire being lighted, the air is forced out of them, by passing volumes of water several times through the whole range; they are then completely filled, the expansion tube being left empty. The pipe by which the apparatus is filled is situated at the bottom of the expansion tube: when the apparatus is filling, the latter is left open, till filled, and the air expelled from the pipes. The filling and expansion tubes are hermetically sealed, by plugging them with screw-plugs.

In both forms of apparatus (low and high temperature), objections have been made, that in cases of bursting, the danger would be great, from the hot water being scattered about. The fact is, that an explosion—which, by the way, very rarely happens—is not attended with dangerous consequences. In the “low temperature” apparatus, if a pipe were to burst, a simple crack would probably be the result: the water would not spread with much force, as, unlike steam, it has a very limited range of elasticity. In the “high temperature”, the water being under high pressure, would issue from the crack or fissure at first in the form of steam, thereafter in that of water, at 212°. Those who have to do with the manufacture of both species of apparatus, express themselves perfectly willing to stand within a few inches of the fissure at the time of rupture. That there is little chance of bursting in the “high temperature” may be judged from the fact, that the pipes are proved at a pressure of three thousand pounds per square inch, and every care is taken in their manufacture to prevent unsound work.

Where heating surfaces of great extent are required, a practical difficulty arises, from inability to provide the necessary space for the pipes, as set up in any of the usually applied forms, more especially in connexion with steam and low temperature hot-water apparatus. In these, a large quantity of hot water or steam is required; hence a large space is occupied to obtain a small effect. The annexed, Fig. 48, is an illustration of a plan, which, it is obvious, will afford a large amount of heating surface, with a small cubical content. A box, of which a transverse section is seen at *B*, is provided with pipes running longitudinally through the interior: these are surrounded by water or steam; the surface presented by each of the internal tubes will, it is evident, heat the air effectively which passes through them: a longitudinal section is seen at *A*. If hot water be used, it enters

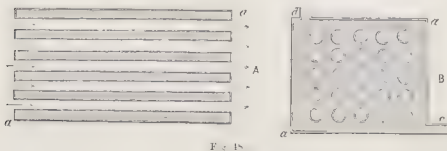


FIG. 48.

the box at the upper side, by the pipe *d*, leaving it at the lower, by the pipe *c*. The apertures, or internal surfaces, may be made in the shape of longitudinal slits, having flat instead of circular sides. By this arrangement, a large amount of surface will be obtained; a box, twelve inches high, and six inches square, giving from its sides about two square feet of surface; but if

four slits or apertures be made to pass through its whole length, half-an-inch wide between their sides, and five inches long, so that space will be left at each end to allow the hot water or steam to circulate round and surround them, four additional feet will be given with the same size of exterior surface. Were this principle to be more generally adopted, greater satisfaction would be obtained, from having to provide less spaces for heating surfaces. The practical difficulty would be making the joints perfectly tight.

Mr. Walker has recently invented and patented an effective form of heating box, which presents a large effective heating surface, yet is, at the same time, simple in its arrangements; and will be kept easily in repair. The inventor describes it as “consisting of a number (more or less, according to the heating surface required) of iron blocks, say six inches square by twelve or fourteen inches high (Fig. 49), each block having square openings, cells, or perforations, passing through it, from the top to the bottom, in a vertical direction. The divisions between the perforations are made extremely thin, so as to require the



FIG. 49.

smallest possible quantity of metal; and the blocks are enclosed within an iron box, in such a manner as to leave one inch for water or steam all round each block. The top and bottom of the box have each square openings, corresponding with the ends of the blocks, so as to permit the ingress and egress of the air to and from the perforations. The box may be quite plain, or ornamented to any desired degree, by metal work; when its exterior, and also the internal perforations, are all efficient heating surfaces. Heat, being applied to the outside of each block, by the passage of hot water or steam into the box, is conducted or communicated through the divisions, and the air contained in the cells or perforations becoming also heated, by contact with the hot surfaces of the divisions, rises into the apartment. The box being fixed over any opening in the floor or wall, communicating with the external atmosphere, a constant stream of fresh and warm air is maintained. The heat may be regulated, or entirely shut off, by a stop-cock in the pipe that supplies the hot water or steam; and the quantity of air may be varied at pleasure, by the ordinary slide, or other valve, fixed in the opening. By this very compact arrangement, one hundred and sixty-six feet of heating surface may be obtained, in a box measuring not more than two feet cube, and no outer casing is required”.

From a strict examination of the principle, and a careful series of experiments as to its heating powers, stated below, this invention will probably be found to be the most effectual yet introduced. In fact, the philosophical principles which govern the transmission of heat seem to be carried out to their fullest extent. The difference between the heating-box described in Fig. 48 and Mr. Walker's (Fig. 49) being, that in the former, the whole heating surfaces are surrounded by the heating medium; while in the latter, the outer surface only is heated, the heat being communicated to the internal perforations entirely by conduction,—the really original and valuable feature of the plan; few joints being required, and the danger of leakage being, to a considerable extent, obviated. It has been considered this plan would be “weak and slow in its operation”. As a proof, however, that it really is not so, and further, as affording an instance of the valuable properties of heated iron as a conducting medium, the results of some experiments made to test its heating powers are here added.

With air in a natural state of quiescence, except only so far as it was set in motion by the heat of the iron:—A block, $6\frac{1}{2}$ inches square, 12 inches long, with 49 perforations, each $\frac{3}{4}$ of an inch square; the divisions $\frac{1}{8}$ of an inch thick; the outer shell $\frac{1}{4}$ of an inch thick; the temperature of water applied to the outer case, 200°; ditto of atmosphere, 56°.

1. The thermometer let down six inches into perforations—

| | | |
|--|---|------|
| In the corner (nearest the water,
the heating medium) indicated | - | 174° |
| In the centre | - | 164° |
| Difference | - | 10° |
2. Bulb of thermometer level with top of block—

| | | |
|-------------------------|---|------|
| At the corner indicated | - | 156° |
| At the centre | - | 152° |
| Difference | - | 4° |

The difference showing that the conducting power of iron, heated by water at a distance from it, results in a temperature little less than that of the portion actually in contact with the heating medium. The difference, 6°, between the two experiments, was probably owing to the bulb in No. 2 being in contact with the iron.

A block, $4\frac{1}{2}$ inches square, 24 inches long, with 49 perforations, each $\frac{1}{8}$ of an inch square; the divisions $\frac{1}{8}$ of an inch thick; outer shell $\frac{1}{2}$ of an inch thick. Temperature of water 200°; atmosphere 50°.

3. The thermometer suspended in a wooden tube bulb twelve inches above block—

| | | |
|---------------------------|---|------|
| Over the corner indicated | - | 135° |
| Over the centre | - | 132° |
| Difference | - | 3° |

In this experiment, it will be observed, that though the heating surface was much increased, nearly in fact doubled, the temperature attained was not so high as in the two former cases; this may be attributed to the fact, that the bulb of the thermometer being close to the heated iron, and within the influence of radiation; whereas, in No. 3, it was purposely placed beyond it. Nevertheless, the result obtained is still decisive as to the fact that there is very little difference between the temperature of the iron heated by contact with the water, that being two inches from it, deriving its heat solely from conduction.

A block of the same external dimensions as that in No. 3, but having no perforations, constituting in fact a square pipe containing hot water. The temperature of water 190°, atmosphere, 64°.

4. The thermometer suspended in a wooden tube bulb twelve inches above the shell—

| | | |
|-------------------------|---|-----|
| Over the side indicated | - | 83° |
| Over the centre | - | 76° |
| Difference | - | 7° |

Here it will be observed, that the air being more highly heated by the block in No. 3, than by the shell in No. 4, passed at a greater velocity, shewing that a much larger quantity of air was heated to a much higher temperature by the block than by the shell.

With air forcibly blown through the perforations by a four-horse power engine, working two double-action air-pumps, each six feet by five feet sectional area; the quantity of air passed being equal to 13,000 cubic feet, at a velocity of eight hundred feet per minute;—Fourteen heat boxes, each containing six perforated blocks, each having forty-nine perforations, the whole amount of heating surface, including that of cases, being 2,240 square feet; notwithstanding the great quantity of air passed, which was such as to lower the temperature of a hot chamber over the heat boxes from 212° to 180° (the former being the temperature when the engine was at rest), the difference between the centre and corner openings could at no time be found more than 10°. To the finger the central opening appeared in no way to differ from the corner one in point of temperature.

The rules for finding the area of hot-water pipes for any required size of apartment, are, in all respects, essentially the same as those given for steam; excepting in one point, that is, the mean temperature of the pipes. In the calculation for

steam pipes, 200° is given; but 140° to 150° may be taken as that of low temperature hot-water pipes.

From the data obtained by HOOD, it appears that water in a pipe of four inches diameter loses .851 of a degree of heat per minute, when the excess of its temperature over that of the surrounding air is 125°; and also that, under the same condition, one foot of such a pipe will heat 222 cubic feet of air one degree in the same time: whence he deduces the following rule:—Multiply 125 by the difference between the maximum proposed temperature of the room and that of the external air, and divide this product by the difference between the temperature of the pipes and that proposed for the room: then the quotient is to be multiplied by the number of cubic feet of air to be warmed per minute; and the product divided by 222 will give the number of feet, in length of pipe of four inches in diameter, required to produce the same effect: this length is to be multiplied by 1.33 or by 2, for equivalent lengths of pipes respectively three and two inches in diameter.

These remarks are to be considered merely as elucidative of the principles and practice of heating as generally adopted; not as recommendatory of any particular plan. It is difficult to say whether the low water apparatus is not superior in work to any other, when properly fitted up by an engineer possessing a thorough knowledge of his subject. In deciding upon the form to be adopted, the architect will be guided by local and other circumstances; these will necessarily vary in different cases.

The admirable arrangement in Franklin's stove presents a feature of the utmost importance, viz., the consumption of smoke; and it clearly points out a means of accomplishing that desideratum. The obvious practical difficulty is the fire-grate: could any material be discovered which would resist the intense action of focal concentration of heat where the flame passes downwards, all the other conditions, of agreeable temperature, cheerful appearance of fire, sufficient ventilation, and perfect freedom from dirt or smoke, would be fulfilled. Were houses built with one central chimney, having an outer case carried up to the full height of this smoke-flue,—forming an air-shaft,—the flues from each stove could be conducted to the chimney, and each apartment could have a ventilating tube leading to the shaft,—the heat of the chimney maintaining a constant upward current therein,—there would be a certainty of warmth and ventilation to every apartment; and a city of such dwellings would possess an atmosphere free from a canopy of smoke with all its attendant disadvantages; in short, the economy and salubrity of the system would be incalculable.

ROBERT S. BURN.

Of the publications upon this subject, the following additional works, (see also VENTILATION), may be mentioned:—

G. P. BOYCE, *Remarks on the different systems of Warming and Ventilating Buildings*, 8vo, 1826; ALF. BEAUMONT, *Hints for preventing Damage by Fire in the Construction and Warming of Buildings*, 8vo, London, 1835; C. SYLVESTER, *The Philosophy of Domestic Economy, as exemplified in the mode of Warming, Ventilating, etc.*, 4to, Nottingham, 1819; W. WALKER, *On the comparative merits of the various systems of Warming Buildings by means of Hot Water*, 1837; H. W. DEWHURST, *Practical Observations on Warming Dwelling Houses and Public Buildings with Hot Water*, 12mo, London, 1832; C. HOOD, *A Practical Treatise on Warming Buildings by Hot Water; on Ventilation, etc.*, third edition, 8vo, London, 1850; COL. W. COOK, *On Warming Rooms by Steam conveyed in Pipes*, Phil. Trans. 1745, p. 370; ROBERTSON BUCHANAN, *Essay on the Warming of Mills and other Buildings by Steam*, 1807; TRANS. SOC. ARTS, 1806, etc.; A. M. PERKINS, *Improved Patent Apparatus for Warming and Ventilating Buildings*, 12mo, London, 1840; J. DAVIES and G. V. RYDER, *On the system of Warming Buildings by Hot Water, a Reply to MR. PERKINS's Answer to the Report presented to the Manchester Assurance Company*, 8vo, Manchester, 1841.

HIP-KNOB.

PLATE XC.

THE term GABLE, HIP, or RIDGE-KNOB, signifies a pinnacle, finial, or other ornament, placed on the top of the hips and ridges of roofs, or on the point of a gable. Crosses have been usually fixed in those situations on ecclesiastical edifices, but on other buildings ornaments of various kinds were used; and when applied to gables with BARGE-BOARDS, the lower part of the hip-knob frequently terminated in a pendant. The architectural forms given to the cross as a hip-knob, scarcely differed from those which it presents in every collection of its shapes; and therefore attention will only be given, in the present instance, to those finials of other forms.

The subject has hitherto met with little attention in England, but in France it has been ably treated. The following observations have been extracted from the work by E. DE LA QUÉRIÈRE, quoted in the article RIDGE, in which a preference is given to examples whose epoch could be ascertained with certainty, either from the date marked upon the fronts of the houses, or from the character of the architecture and ornamentation.

It is supposed that the word "épi" arose from the similarity existing between the ornaments so called, and ears of corn (épis de blé); nevertheless, it seems that the origin of épi, espi, would be more correctly given as espié, espiel, espict, espièu, i. e. épée, etc., and in general anything pointed, from spina, as is found in the *Glossaire de la Langue Romane* of ROQUEFORT. That the term "espi" was used in the fifteenth century, is proved by a manuscript (*Comptes de la fabrique de la paroisse Saint Laurent de Rouen*, suppressed in 1791, for the year 1470-1471), in the archives of the Département de la Seine Inférieure, in the dépôt of the ancient library of the cathedral of Rouen, which says: "A Cardinot le Pelletier, pour cent liures de plomb, n'est pas comprise la peine et salaire de la façon des cinq *espis* des chapelles du hault de l'esglise tant de costé que d'autre comenchés à faire et mesme du plomb."

Although at Caudebec-en-Caux there is a stone house of the thirteenth century, exhibiting upon its gable a contemporary capital, which probably bore a statue or some such object, there are no sufficiently authenticated examples of hip-knobs earlier than the fifteenth century; which is the more remarkable, as VANES (in themselves a branch of the present subject) and hip-knobs were marks of distinction appropriated to the châteaux and hôtels of feudal times: and although all the civil and religious edifices of any importance of the fifteenth and sixteenth cen-

turies, and of a great part of the seventeenth, were ornamented with crests and hip-knobs, and had the leadwork of their ridges glistening with gilding and painting. In the Département du Cher, the Château de Meillant offers an extremely rare example of the complete decoration of an ancient roof (RIDGE, Plate 81, Fig. 9): this and the specimens at Abbeville; and also those on the apse of Evreux cathedral; those of the cathedral, of the arcade of the Grosse Horloge, of the Palais de Justice, and of the tower of S. Romain at Rouen, are all mentioned on the second page of the description to Plate 81, RIDGE, as well as a drawing of such a careful termination of a roof, which was designed in the time of Francis I, for the church of S. Vincent at Rouen.

At Alençon, near the church, in the place Notre-Dame, is a house of the sixteenth century, having two vanes and a hip-knob in the style of the Renaissance. At Argentan, in the rue des Capucins, there are some fine complete hip-knobs of the seventeenth century, with some others which are very remarkable: in the place de la Cathédral at Auxerre, there remains a curious fragment of a hip-knob of the fifteenth century, at the top of a turret belonging to a private house; also a hip-knob of the seventeenth century on a house in the rue des Lombards: those of the old Hôtel Dieu at Beaune may be mentioned; also those of a house at Caen of the sixteenth century, in the rue du Moulin, at the bottom of a large court. At Dijon are the vanes of the Hôtel de Mimeure and the hip-knob of the Hôtel Chambellan, and at Delft are two peculiar hip-knobs. On the château at Eu there are four hip-knobs of the sixteenth century, and four others of the seventeenth. At Gien are those of the château, of the time of Louis XII: at Lisieux some mutilated hip-knobs, among others that of the house in the rue aux Fèvres: at Mans, that of a turret, which is near the south portal of the cathedral. At Paris some are remaining in the Place Royale and some at the Préfecture de Police, all of the time of Louis XIII; at Reims are those of the Hôtel-de-Ville; and at Troyes the vanes of the old Hôtel de Vauluisant, built at the epoch of the Renaissance; one of these represents the sun, the other is the crescent moon surrounded with stars; both the stems are very high, and ornamented with dolphins, etc.: another charming vane of the same epoch, about fourteen feet high, attracts notice at the foot of the rue de la Monnaie, facing the rue des Croisettes. At Vitry are the hip-knobs of the

castle, and Verneuil possesses the remains of a hip-knob of the end of the fifteenth century, upon a turret, corbelled out from the angle of an important and very remarkable house in the rue de la Madeleine.

There are three ornamental vanes at Epernay, besides other vanes and hip-knobs remaining in divers places in Brittany; at Quimper-Corantin; Brest; on the hospital at Landernau; and on the châteaux of Brignon, of Kéroel or Kérouel, and Tréséol; the vanes of this last bear the date of 1642. In the hip-knob with the vane observable at the town of Brest, anchors are employed. According to M. Ch. Grouet, very curious vanes of the sixteenth century are to be seen at Grange-le-Roi (Seine and Marne), at the château of the celebrated Fouquet, built in the seventeenth century and situated at Vaux-le-Praslin; also at Dôle (Jura) and at Gray (Haute-Saône).

This enumeration is poor in comparison with the numerous examples that Rouen is able, notwithstanding its daily losses, to offer to the curiosity of strangers, particularly if the types belonging to the latter half of the seventeenth century are included, which still present themselves in large numbers.

It may here be mentioned that the artists of that period always reproduced in lead, what was done in stone, according to the types of ornamentation of the period. In point of fact, however, the hip-knobs of the fifteenth century have become so extremely rare, that even Rouen offers no more than five examples. These consist of two fragments, one on the houses No. 112-114, rue Martainville, and No. 23, rue de la Grosse Horloge, or Grande Rue, Fig. 7 (as restored by LA QUÉRIÈRE); the base of this last very much resembles that shown, Fig. 5 of Plate 81, RIDGE; and another of this description, very well preserved, remains on the ridge of the chapel of the Virgin at Evreux cathedral, and another upon the church de la Madeleine, at Verneuil (Eure): two others are to be seen, the first upon the chapel of the hospice at Orbec (Calvados), the second at Paris, in the cul-de-sac des Bourdonnais; the latter is terminated by a bouquet of lilies. The hip-knob upon a turret in the rue de la Madeleine at Verneuil, is of a different type to the above; and upon the chapel called des Machabées, adjoining to the cathedral of Amiens, is one of the same century deserving of notice. There are some perfect and extremely remarkable examples (Fig. 9) at the chateau de Martainville-sur-Ry, near Rouen. The other specimens at Rouen comprise one (Fig. 8), mutilated but analogous to no other known example, springing from the top of one of the turrets of the archbishop's palace in the rue S. Romain, facing the rue des Chanoines; it has a very high stalk, bearing four rays sculptured into foliage, the termination of which could not be ascertained: a wooden turret of the fifteenth century, enclosing the staircase of the house, No. 17, rue Bouvreuil, and covered by a high pitched roof, surmounted by a very dilapidated vane; and lastly, the turret aux Pastorales of the Hôtel du Bourgtheroulde, furnishes a remarkable example of the ornamentation of the hip-knobs of the end of the fifteenth century, Fig. 3. The crowning of the hexagonal slate roof is enveloped with a network of lead, bearing foliage on the hips. From the summit of this point springs a high iron stalk, bearing a large thistle flower (which, like the lily, was very common at that time), around this other thistles were grouped, now reduced to a very small number. At Verneuil, the turret corbelled out from the fine stone house of the time of Louis XII, at the angle of the rue du Pont-aux-Chèvres, has a bouquet composed of four lilies, surmounted by a vane, also having a lily at its summit, the whole in ironwork.

At Rouen are several buildings of the fifteenth century with overhanging stories, having above their gables the rudiments of hip-knobs no longer in existence. Such are the houses in the rue Grand-Pont, No. 60-62, at the angle of the rue de la Madeleine; rue du Bac, No. 66, at the angle of the rue des Fourchettes; rue des Charettes, No. 20, facing the rue de la Comédie; and the house formerly called "Caradas", from the

name of the proprietors, an important and curious construction, with two stories, occupying all one side of the rue de la Tuile to the rue de la Savonnerie. This house is engraved in vol. ii of the author's *Description Historique des Maisons de Rouen*, etc.

The epoch of the Renaissance is the most fruitful in fine and elegant hip-knobs of every description; it was also the time when good taste was invariably shown. Upon a base, mostly square, with more height than breadth, with mouldings, ornamented on its faces with little grotesque heads or tablets, is placed a candelabrum, an elegant vase, a flower-basket, or an urn, of a light and graceful form, and springing from which are leaves, flowers, and fruits. This base likewise sometimes supports small figures.

The different pieces which compose the épi or hip-knob, fitted one above the other, are held together by an iron rod, which passes through them and comprises the basis; this at its lower extremity divides into four branches, to clasp, if the expression may be used, the post upon which the entire hip-knob is fixed. This piece of wood called an "épi," has probably given its name to the ornaments with which it is finished. The height of the best hip-knobs of private houses varies from three to six feet, but there are some, principally with vanes, which are as much as from twelve to fifteen feet.

Two of the four hip-knobs, which existed upon a house in the rue des Charettes, Nos. 100-102, have been measured and weighed. They are each four feet four inches in height. The weight of an iron stalk of this length is sixteen pounds; and that of the lead of a hip-knob is from eighty-five to ninety pounds. So that the total weight of each hip-knob is a little less than one hundred and six pounds.

In places where potteries existed, crests and hip-knobs were made of burnt clay, also ornamental ridge-tiles (in the neighbourhood of Etampes, ridge-tiles have been discovered surmounted by a trefoil). Hip-knobs of burnt clay, perfectly executed and greatly resembling lead, have been seen in different localities, especially in Lower Normandy, at Alençon, Bayeux, Coutances; above all at Falaise (two hip-knobs of the Renaissance upon the Prefecture, rue Basse), and at Domfront, upon the Maison-du-Juge-de-paix, of the same period, and upon other houses.

After searching among a number of collections of drawings and engravings for examples, the author was only able to find two sheets, each containing four designs for hip-knobs of the end of the Renaissance and of the sixteenth century. These form part of a volume of manuscript designs by Jacques Androuet-Ducerceau, deposited in the Bibliothèque de Sainte Geneviève at Paris.

Fables, allegory, mythology, social life, and religion, have furnished numerous subjects, both various and graceful, for the finishing of the coverings of roofs. Thus a little soldier, armed from head to foot, is to be seen at Rouen upon a house of the Renaissance, rue Saint Denis, No. 38. A sort of bully, with a drawn sword, still figures over a window at the house, No. 11, rue Herbière; likewise some little Cupids, with quiver on shoulder and bow in hand, shoot very innocent arrows from above lucarnes (from whence they have seen three hundred years), in rue du Bac, No. 40, seemingly at one of their brethren, still remaining in the place du Vieux-Marché, at the corner of the rue du Vieux-Palais. Another infant, also drawing a bow, belonged to the house rue Ecuillère, No. 44; but an amateur having by chance spied it out, roosting on its lucarne, had it taken down to ornament his country house. It would appear that this *motif* is often copied at Rouen, for at Dieppedalle, three miles from the town, upon a house with a steep roof, there are two little naked figures, one of a child drawing a bow, the other of Neptune.

Lastly, Justice, Strength, Hebe, Temperance, and Prudence, statues as large as life, the first and last executed in a very remarkable manner, complete, with magnificent hip-knobs, the

picturesque appearance of the Château d'Angerville-Bailleur, built in the year 1543, and situated in the Pays de Caux, in the canton of Goderville (Seine-Inférieure).

Statues and hip-knobs also figure upon religious edifices. At the cathedral of Rouen, the chapel of the Virgin still shows, upon the hip-roof of its apse, a fine statue of the mother of the Saviour, and a magnificent hip-knob of the sixteenth century (Fig. 10). At the church of Saint-Ouen, was formerly an angel, such as still remains at Rheims, over the choir of the cathedral; and at the cathedral of Toul, near the enclosure (*Lanternon*) of the clock. At Falaise, the chapels at the north of the nave of the church of the Trinity, are surmounted by a leaden figure, and each figure is in a different attitude. At L'Aigle, at the summit of the high-pitched slate roof of the bell-tower of the principal church, between two badly-executed colossal statues of angels in lead, rises a hip-knob, composed of several tiers of lilies overlaying each other; the whole surmounted by an eagle, in allusion to the name of the town. On the south aisle of the same church, is a hip-knob formed of lilies. Fine ones are to be seen at the cathedrals of Amiens and Rouen, the church at Aumale, etc. There still remain a few scattered over the turrets of some of the old châteaux. As to those of city habitations, they have been almost all annihilated.

The most curious hip-knobs of the sixteenth century now remaining at Rouen, are those with vanes, on a building at the bottom of the court-yard of the house No. 6, rue Herbière (Fig. 4). That which is seen at the top of the staircase of the house, externally decorated with arabesques, in the rue de l'Hôpital, No. 1, nearly resembles Fig. 5; those, originally four in number, but now reduced to two, in the rue des Charettes, No. 100-102 (Fig. 5), upon a stone house dated 1587, destined to be removed for the indispensable enlargement of this street. Those which are seen at the old Hôtel de Senneville, No. 30, rue Damiette; rue Bouvreuil, No. 24-26, over a building at the bottom of a court; rue de l'Ecureuil, No. 14; rue de la Grosse Horloge, No. 159; and rue du Coquet, No. 5. There still remain other very pretty hip-knobs of this epoch, which must be passed over, though they have become rare. But the leaden swan crowning the house numbered 12, 14, and 16, rue de la Cicogne, must not be omitted; it was certainly repeated as a sign in a more conspicuous place, and gave its name to the street.

As types for the end of the sixteenth century, and the commencement of the seventeenth, the hip-knobs of the large stone house, rue des Carmes, No. 66-77, at the corner of the rue Saint-Lô (Fig. 6) may be given as representations. A head of a bearded man, in profile, of good execution, adorns the return of the square of this house at the rue Saint-Lô. Unfortunately, almost all the sculptures upon the side of this house have disappeared under pretence of embellishment.

Attention is directed to the hip-knobs of the period of Henry IV, which decorate a remarkable stone house, bearing the date 1601, Grand Rue, No. 101-103; and another house, rue Saint Hilaire, No. 130. This is almost all that is known here of this sort, a fashion which arose in the midst of the traditions of the Renaissance, traditions which have been followed to a recent time, as is proved by the hip-knobs of the rue du Renard, No. 59; and those of the rue Bouvreuil, Nos. 24, 26 (Fig. 14.)

Under Louis XIII, the form of the hip-knobs was affected by the heavy style into which the arts dependent upon design had fallen. The bases, formerly imitated from the antique, take a distorted form. Vases, often of a not very graceful outline, with or without handles, are still employed; but frequently the base of the hip-knob bears a ball surrounded with foliage, and surmounted with a stalk more or less ornamented.

Fine examples of this description are to be seen at the house called the "Swan", dated 1631, in the rue Cauchoise, No. 47, (Fig. 2); rue des Charettes, No. 83, at the corner of the rue Haranguerie, dated 1640 (Fig. 1); rue des Carmes, No. 80,

at the corner of the rue de la Chaîne; again at No. 15; rue Saint-Patrice, No. 36, facing the rue Etoupée; place de la Pucelle d'Orléans, No. 12; rue Saint-Georges, Nos. 5-7; rue aux Ours, No. 69; also at No. 45: the latter showing a blooming bouquet; rue des Cordeliers, No. 29; rue des Vergétiers, No. 17; rue Ganterie, No. 104; rue des Bons Enfants, Nos. 41-43; rue Boutard, No. 21, etc. Lastly, at the main building at the bottom of the court of the beautiful timbered house in the rue de la Grosse-Horloge, No. 115: the latter (Fig. 11), which are very curious, have figures of children placed round the base of a large vase (*cassolette*). Also may be mentioned the three large hip-knobs of the house No. 17, rue Herbière (RIDGE, Plate 81, Fig. 2).

In the second half of the seventeenth century, under the minority of Louis XIV, the hip-knobs still more degenerated; some are, however, to be found, remarkable for their originality, such as that (Fig. 12) of the house No. 95, rue de la Vicomté, formerly du Merrier, dated 1643. From that time they are generally a quadrangular pyramid, accompanied by four handles in bad taste, and terminated by a sort of cabbage. Frequently these hip-knobs, employed with lucarnes, are short and stunted, like those are on the houses in the rue Saint Antoine, near the Marché-Neuf; or those of the houses built in 1663 for the old monks of Saint Lô and occupying all the side of the rue de Socrate (before the Revolution, rue Neuve Saint Lô); or those still on the house rue des Fossés-Louis VIII, No. 28, bearing the date of 1666.

The description of hip-knob (Fig. 13), of which numerous examples present themselves in town and country, offers a variety known by a species of plume, like those of the rue de la Vicomté, just mentioned.

Nevertheless, art sustained itself to the end of the reign of Louis XIV. The proof thereof is seen in the hip-knobs of a house situated in the faubourg d'Eauplet, No. 63 (RIDGE, Plate 81, Fig. 3), built about 1680; and the hip-knob, consisting of a heart pierced with arrows in saltire, and crowned with flowers, to be seen on the roof of the ancient convent of the barefooted Augustines, founded in 1674, in the place du Champ de Mars. But at the accession of Louis XV, this kind of ornament clearly showed that it had had its day. During the greater part of the eighteenth century, it was nothing more than a pedestal, upon which was mounted a very simple urn (abbey Fécamp), or a reversed pear (Hôtel de Ville at Rouen, formerly the dormitory of the monks of St. Ouen; the presbytery of the parish church of Saint Vincent; the house No. 61, rue du Renard, etc. etc.); or a ball accompanied by a few leaves (quay du Mont Riboudet, No. 44), which at last altogether disappeared, only to leave a plain ball upon a pedestal. This ball or little globe, now almost always made of tin or zinc, gilt in some districts, is sometimes borne by a little quadrangular pyramid of the same metal, instead of lead, the material always used in former times.

To complete this portion of the subject, it may be useful to add La QUÉRIÈRE's remarks upon the *girouette* or vane, which probably ought always to have surmounted the *épi* or hip-knob. As the embattlements and turrets which served for the defence of the châteaux showed nobility, so only gentlemen had the privilege of adorning the ridges of their houses with vanes, which were pointed like pennons for simple chevaliers, and square like banners for the knights bannerets. (LA CURNE DE SAINTE PALAYE, *Mémoires sur l'Ancienne Chevalerie*, Paris, 1826, vol. i, p. 26.)

According to RENAULDONT (*Dictionnaire des Fiefs et des Droits Seigneuriaux*, etc., 4to, Paris, 1745), there were two kinds of vanes, simple and square. The nobles and proprietors of a fief might place simple vanes on their houses and dovecots; but he thought that the tenant had not this right, because it was a mark of the nobility of the person or estate. With respect to square vanes, as they were seigneurial marks, the lord might prevent the vassal and tenant from using them, as was judged

by a decree of the parliament of Bourdeaux, recited by LAPEYRÈRE.

On this subject, the entrance gate of the ancient Charter House of Val-Dieu, near Mortagne (Orne) may be cited; it is a portal built in the eighteenth century, where there are two square vanes, bearing the arms of Rotrou, its first founders; they are made of iron, cut in open work. Very few of the vanes now remaining have preserved the primitive character of the middle ages, for only those just mentioned were known to LA QUÉRIÈRE.

"On the turrets of the southern châteaux," says MARCHANDY (*Gaule Poétique*, 4th edit., vol. iii, pp. 99, 100), "we see vanes in the form of cocks. The right of placing vanes upon a château," continues the same author, "only belonged, in the commencement, to those who were the first to mount in an assault, and who had planted their banner upon the rampart of an enemy: therefore they gave to these vanes the shape of a flag, and painted on them the arms of the master of the place."

The most conspicuous modern vanes are composed of a rod of iron, crossed at right-angles by two others, much shorter, at

the extremities of which are indicated the four cardinal points, by the Roman initial letters N., S., E., W., gilt. The vane properly so called, of wrought iron or "*tole*", *i. e.* tin-plate, placed above, consists of the union of several gilt arrows, usually three, turning on the axis of the stalk; sometimes even a single arrow is sufficient. Other vanes show different fanciful subjects; sometimes an animal, a figure of Fame, a hunter, the sun, moon, etc. etc. In the seventeenth century, and during the eighteenth, an open-mouthed head was commonly employed.

In some localities (among others, at Troyes), there is a special elegance in the fabrication of modern vanes and hip-knobs. The stalks are ornamented with little globes, pierced; with balls armed with points, forming stars; with crescents, etc. etc.

Hip-knobs have disappeared, through time and other causes; among these, are the ignorance and carelessness of proprietors, and the unskilfulness or bad intentions of plumbers. It is thus that throughout France, the greater number of old houses, public buildings, and even churches, have successively been despoiled of the ornaments which crowned their summits.

A. W. MORANT.

HIPKNOB

